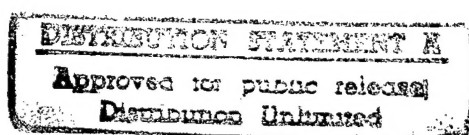




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JPRS Report



Science & Technology

***USSR: Electronics &
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Achievements and Problems of High-Definition Television

907K0280A Moscow *TEKHNICA KINO I TELEVIDENIYA* in Russian No 5, May 90 pp 16-27

[Article by V.A. Khleborodov]

[Abstract] A global model has been developed for the system which will provide high-definition television, including the channels of signal distribution and the supply of video cassettes and disks. Television centers, the core of the system, must be able to use a number of different standards (i.e., 525-line and 625-line formats) in analog or digital mode. They should be able to issue standard signals by ground communications, satellite, cable, disks, or cassettes. The viewer could choose high-quality or high-definition television with a full frequency band or a reduced frequency band. Home television sets would support both.

The International Consulting Committee on Radio plans to choose a global studio standard. The parameters of a variety of proposed standards are presented in tables. The committee feels that the future of high-definition television is irrevocably linked with digital equipment, and thus, a digital standard.

The advantages and disadvantages of each standard are discussed, and the information presented in the tables is expanded. Figures 3; tables 2; references 15: 8 Russian 7 Western.

UDC 621.397.13:629.783+621.397.444

Satellite Television: What's Between the Lines of International Agreements?

907K0280B Moscow *TEKHNICA KINO I TELEVIDENIYA* in Russian No 5, May 90 pp 46-52

[Article by A.P. Altayskiy]

[Abstract] A new multilateral convention to prevent unauthorized secondary transmission of signals from satellites has been drafted. The convention is couched in the terms of international publishing law, and this makes it possible to individual governments to implement their own means of suppressing piracy.

Article 1 defines the terms of the agreement according to legal standards. Article 2 defines the jurisdiction of the convention and makes governments responsible for preventing transmission to or from their territory of any signal by any transmission device for which the signal is not intended. The convention is to remain in effect for 20 years, and does not encompass ground communications. Article 3 outlines what may and may not be directly broadcast. Article 4 expands upon the exclusions to Article 3.

In Article 5, the juridical status of the signal transmitted to the satellite remains in effect, barring other resolutions. The convention is not retroactive. Article 6 protects the interests of those who invest in programs. Article 7 fully supports national laws on misuse by monopolies.

Satellite TV Reception: Antennas for 11-to-12 GHz Band

907K0281A Moscow *RADIO* in Russian No 4, Apr 90 pp 48-53, 88

[Article under the rubric "Video Techniques" by G. Tsurikov, A. Kvitko and V. Fadeyev, Moscow]

[Abstract] A direct-broadcasting-from-satellite system using the 11-to-12 GHz band (the STV-12 system) is nearing completion in the USSR. Detailed directions, geared to the radio amateur, are given for constructing a 1.5-m-diameter single-mirror parabolic receiving antenna. The horn feed is described, dimensioned for a 1.5-m, 160°-aperture reflector for use with Moskva receiving equipment. The antenna's gain equals 42.5 dB, pattern width at -3 dB level about 1.5°, first-few-minor-lobe level of -25 dB, noise temperature with an elevation tilt of 10° and more not higher than 60 K, and voltage standing-wave ratio about 1.4. A rotating support using a so-called polar suspension for the reflector is recommended and the screw-and-nut mechanism for rotating the antenna on its polar axis is described in detail. The steel pipe used for the support is 90 to 100 mm in diameter and has a wall thickness of 4 to 5 mm to withstand 25-to-30-m/s winds. Fiberglass-reinforced plastic is recommended for the most complicated step of making the reflector. The form for molding the plastic reflector can be made from cement mortar or a sand-and-water-glass mixture on a wire frame. The procedure for aiming the antenna at satellites is described. The use of a theodolite is recommended for greater accuracy. Final adjustments for receiving the strongest signal are enumerated. Figures 14.

4USTsT Televisions. Control Units: 1. Push Button System

907K0281B Moscow *RADIO* in Russian No 4, Apr 90 pp 54-56

[Article under the rubric "Video Techniques" by V. Zakharov, Moscow]

[Abstract] There are several modifications of type 4USTsT televisions with various control unit designs. The soft-touch pushbutton control system for the Rubin 51/61 TTs405D television set is described. The A9 control unit consists of an MVP-2 program selector module and a display and switching board. It also contains variable resistors for picture brightness, color saturation and contrast control and sound volume control. The television also features treble and bass controls, a sound shut-off button and jacks for connecting a tape recorder or external loudspeaker and headphones. The

control button system makes it possible to select one of eight TV programs by pushing the proper button and to tune each of the eight control buttons to any VHF or UHF TV channel in three subbands. The preset channel selector subband is switched in by the transmission of voltages through three circuits. When the set is turned on it is ready to receive the program to which the first button has been tuned. The eighth button makes it possible for the TV set to work with a video tape recorder. The control unit incorporates a type KR1106KhP2 microcircuit functioning as an electronic switch. Designed for use in TV electronic tuners, this microcircuit makes it possible to select a program and store it, switch the tuning voltage, control the subband selection switches, and to generate signals for controlling a seven-element digital display and for blocking automatic frequency tuning (AFT). The microcircuit incorporates 16 output switches: eight tuning switches, seven display switches and an AFT blocking pulse generator. The control system's operation is described in detail. Trimmer resistors are used to store the required tuning voltage for the television channel of the program selected, which is shown by means of a type ILTs1-1/9 vacuum-tube display. Figures 3.

Calculation of Equalizer by Means of 'Elektronika' B3-34 Microcalculator

907K0281C Moscow RADIO in Russian No 4, Apr 90 p 59

[Article under the rubric "Audio Engineering" by D. Kuznetsov, Chelyabinsk]

[Abstract] Calculation of an equalizer by means of the Elektronika B3-34 Microcalculator was discussed earlier

in RADIO, No 6, 1987. Here a simpler procedure is discussed for the calculation of band filters and for the selection of parts. A calculation program for the Elektronika B3-34 is presented. Four identical capacitors each are needed for each band for a stereophonic equalizer. The first step of the procedure is to select capacitors having monotonically decreasing capacitances and with intervals close to the intervals between the equalizer's frequency bands. It is possible to use capacitors having the same capacitance value for the filters of two adjacent frequency bands, or to increase the interval between capacitances. Then the necessary Q factor is selected ($Q = 1.4$ to 1.7 for a 10-band equalizer), and then the gain, the interval between frequency bands in octaves, and the equalizer's bottom frequency (usually 31.5 Hz for a 10-band equalizer). Then the rated values of the resistors are calculated according to the program. Resistances are calculated for the first frequency band, and then the resonance frequency of the next filter is calculated. The filters' parameters are calculated successively in the order of increasing frequency. Resistance values are rounded to the nearest standard values. The filter circuit chosen constitutes an inverting operational amplifier with frequency-dependent negative feedback. A voltage follower is added to the equalizer's input. The tolerances for deviation of the parts' rated values from the calculated become tougher as the number of equalizer bands increases. The calculation procedure discussed is much simpler than the one published before. However, the simplified formulas used for calculating the parameters of band filters and their elements result in poorer accuracy of the end results. Figures 1.

UDC 550.388.2

Double Stimulated Scattering of Electromagnetic Waves in Ionospheric Plasma

907K0210A Moscow GEOMAGNETIZM I
AERONOMIYA in Russian Vol 30 No 1, Jan 90
pp 82-89

[Article by A.N. Karashtin and M.Sh. Tsimring, Gorkiy Scientific Research Institute of Radiophysics]

[Abstract] Double stimulated scattering of a high-frequency electromagnetic wave upon its oblique incidence on a plane layer of magnetically active isothermal plasma is considered, this electromagnetic wave riding on a low-frequency fast magnetic sound wave which propagates perpendicularly to the plasma concentration gradient and almost perpendicularly across the external magnetic field. Analysis of this process is based on the system of Maxwell equations and the wave equation for magnetic sound in a nonuniform high-frequency electric field. The plasma concentration is regarded as the sum of a quiescent component and a perturbation in the sound wave. The solution to those equations yields the amplitude of the threshold field intensity of an incident electromagnetic wave field for its double stimulated scattering, corresponding to a zero power reflection coefficient. In the case of an ionospheric layer there is no analytical expression obtainable for the threshold field and, therefore, the equations must be solved by numerical methods. Calculations for the F-layer above moderate latitudes have yielded data on the dependence of that threshold field on the angle ($85.5-88.5^\circ$) which the sound wave vector makes with the magnetic field vector (frequency of electromagnetic wave 9.31 MHz, angle of incidence 6°) and on the frequency of the electromagnetic wave (6-10 MHz, angle of incidence 6°). The results indicate that experimental observation of double stimulated scattering in the ionosphere is feasible, with the aid of test equipment such as the "Sura" apparatus, and they indicate the conditions under which this should be possible. Figures 3; references 10.

UDC 550.388.2:523.98

Nocturnal Peaking of Ionization Within F-Layer Above Cuba: Relation to Solar Activity

907K0210B Moscow GEOMAGNETIZM I
AERONOMIYA in Russian Vol 30 No 1, Jan 90
pp 98-106

[Article by L. Lois, J. Perez, B. Laso, N. Jakowski, and R. Landrock, Institute of Geophysics and Astronomy, Cuban Academy of Sciences, and Institute of Space Research, GDR Academy of Sciences]

[Abstract] Nocturnal peaking of ionization within the ionospheric F-layer above Cuba is analyzed statistically on the basis of measurements made over the 1974-80 period. The principal indicators here are the electron

concentration N_F and the critical frequency f_oF2 , auxiliary measurements with a Faraday polarimeter having yielded data on the Faraday angle needed for determination of the N_F and data on the layer thickness according to the Bradley-Dudeney model having been used for determination of the altitudinal $N(h)$ profile widening. The method of analysis is based on approximation of the two ionization indicators as linear functions of time during both rise and fall periods. The statistical analysis is based on 746 events of N_F peaking and 1308 events of f_oF2 peaking. As a supplementary indicator of ionization changes was calculated the integral ionization intensity corresponding to various rates of nocturnal changes. The data cover periods of weak and strong solar activity, in winter, in summer, and during equinoxes. The anomalous peaking of ionization is, on the basis of this study, correlated with plasma transport along global magnetic lines of force dependent not only on the geography and on the season but also appreciably on the solar activity. During periods of weak solar activity these nocturnal peaks occur almost every night in winter, most intensely about solstice time, and only sporadically in summer. During periods of strong solar activity these nocturnal peaks, of shorter duration but higher intensity, reach their maximum levels in summer. Figures 6; references 24.

UDC 550.388.2

Oblique Sounding of Ionosphere with Continuous Linearly Frequency-Modulated Signals

907K0210C Moscow GEOMAGNETIZM I
AERONOMIYA in Russian Vol 30 No 1, Jan 90
pp 107-112

[Article by V.A. Ivanov, V.P. Uryadov, V.A. Frolov, and V.V. Shumayev, Mari Polytechnic Institute]

[Abstract] The ionosphere above moderate latitudes was sounded with continuous linearly frequency-modulated short-wave radio signals in an experiment using rhombic transmitter and receiver antennas. Measurements were made along the 2700 km long Alma Ata-Gorkiy route over the June-July 1987 period, noteworthy being the appearance of a wideband $2E_s$ mode on the distance-frequency characteristics, then along the 5800 km long Khabarovsk-Gorkiy route over the 13 March-3 April 1988 period coinciding with magnetic storms and a much more probable appearance of the 3F2 Pedersen mode during morning or evening hours. The authors thank L.M. Yerukhimov, N.A. Mityakov, V.S. Maksimov, E.G. Mirmovich, N.A. Kurmuzakov, N.D. Krupenny, A.M. Leonov, N.G. Serebryanitskiy, and I.V. Popkov for assisting in the experiments. Figures 4; references 10.

UDC 551.466.1

Measurement of 'Sea Surface-Radar Signal' Modulation Transfer Function at 3-cm Wavelength*907K0224A Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 33 No 1, Jan 90 pp 3-11*

[Article by A.D. Rozenberg, Institute of Oceanology, USSR Academy of Sciences]

[Abstract] Measurements with a pulsed coherent navigational radar at the 3-cm wavelength were made during the June-September 1972 period along the Black Sea coast, for a validation of this method of determining the parameters of sea ripple from the frequency characteristics of signals scattered by the sea surface and then on this basis calculating the modulation transfer function. The radar station was installed on a cape, its equipment including an echo resonator cavity for storage of the signal phase and then a high-frequency phase shifter before one of the two heterodyne mixer mixer. This mixer was followed by an intermediate-frequency amplifier, this amplifier and the one behind the other mixer feeding signals to a phase detector followed by a peak detector which also received signals from a range selector through a strobing circuit. Output signals from the peak detector were recorded on magnetic tape along with output signals from a d.c. string ondograph, the latter having been mounted on a buoy 400 m away from the coast and 60 m under the water surface. The antenna was mounted on a mast 12 m above sea level, on the beach 50 m behind the water front, the grazing angle being variable over the 1-4.5° range for distances covering the 150-750 m range. Measurements were made under calm conditions, each measurement was made with vertically polarized and horizontally polarized signals. The readings have been analyzed for "instantaneous" frequency spectra of wave energy and spectral density at the upper cutoff frequency (100 Hz), also for determination of upper and lower 3 db corner frequencies. From these spectra has been obtained the modulation transfer function, which depends on the wind velocity as well as on the range, on the angle of signal incidence, and strongly on the signal polarization. An evaluation of the results has yielded values of the coherence function comparable with those based on earlier measurements from platforms, but 1.5-2 time lower absolute values of the modulation transfer function. The author thanks I.A. Leykin for helpful discussions. Figures 4; tables 1; references 8.

UDC 621.396

Effect of Near Fields on Local Perturbation of Earth-to-Ionosphere Distance*907K0224B Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 33 No 1, Jan 90 pp 12-16*

[Article by A.P. Nikolayenko, Institute of Radio Astronomy, UkSSR Academy of Sciences]

[Abstract] The problem of diffraction of a infralow-frequency electromagnetic field by a local inhomogeneity

within the cavity between Earth and ionosphere is solved on the basis of the Stratton-Chu integral equation with Green's function in the Born approximation of the perturbation theory and so as to reveal how the near fields influence the solution. The cavity between Earth and ionosphere is assumed to be excited by a vertical electric dipole on the surface of Earth and the resulting local inhomogeneity in the lower ionosphere above that field source is assumed to be a circular with a diameter much smaller than the wavelength of the electromagnetic radiation, the configuration of the problem being an axisymmetric one. Considering vertical propagation of radio waves describable by null-mode normal field component and using the conventional dispersion law, calculations yield the perturbation of an otherwise uniform Earth-to-ionosphere distance (altitude of the ionospheric layer above Earth). The physical significance of the results is, disregarding the curvature of the Earth surface, that such a local change in that distance (altitude) is equivalent to the change in the current moment of the field source. The electrostatic component of the field at the lower boundary of the ionosphere is much more perturbed than its induced component and even more so than its radiation component, the thickness of the ionospheric layer into which the field penetrates being approximately equal to the altitude of its lower boundary. The author thanks G.I. Makarov, V.V. Kirillov, and Yu.P. Galyuk for helpful discussion and constructive critique. Figures 1; tables 1; references 5.

UDC 538.566

Influence of Terrain Relief on Low-Frequency Electromagnetic Field*907K0224C Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 33 No 1, Jan 90 pp 17-21*

[Article by O.G. Kozina and G.I. Makarov, Leningrad State University]

[Abstract] The effect of geometrical nonuniformity such as a surface relief on the performance of low-frequency antennas is analyzed, convex and concave cylindrical surface deformities being considered whose dimensions are much smaller than the radiation wavelength in vacuum and which cut the level surface or, in the more general case of a curving surface, the plane tangent to it at any angle from $\pi/2$ to π (hill) and from π to 3π (valley). The analysis is based on the Leontovich relation between tangential electric and magnetic field components, assuming that both principal radii of surface curvature are larger than the radiation in the lower medium. Analysis of the problem in the complex plane with the Meixner condition at the edge, after several conformal transformations, leads to the Laplace equation which here needs to be solved for a half-plane with Neumann boundary conditions only. The effect of terrain nonuniformity, characterized by the ratio of the tangential

magnetic field components at a surface deformity and at a level surface respectively, is found to increase with decreasing distance from the antenna and with increasing width of that deformity: the field radiated by an antenna on level ground becomes weaker at a hill and stronger at a valley. Figures 4; references 9.

UDC 538.574.6

Asymptotic Differential Radiation Conditions for Three-Dimensional Diffraction Problems

907K0224D Gorkiy IZVESTIYA VYSSHIKH
UCHEBNIKH ZAVEDENIY: RADIOFIZIKA
in Russian Vol 33 No 1, Jan 90 pp 85-92

[Article by A.B. Samokhin and S.V. Tsvetkov, Moscow Institute of Radio Engineering, Electronics, and Automation]

[Abstract] Asymptotic differential boundary conditions of order-0($[³]$) accuracy are proposed for the three-dimensional diffraction problem, these boundary conditions including transverse space derivatives so that such a high accuracy becomes attainable. As a consequence, however, there would be several several solutions to this boundary-value problem rather than a unique one. The problem is regularized by insertion of a corrective term containing fourth-order transverse space derivatives into the differential operator so as to ensure, without lowering the accuracy of the approximations, uniqueness of the solution to a strongly elliptical equation more appropriate than the conventional Maxwell equations for the electric field. The problem is formulated in a bounded region first, for solution by the method of finite elements on the basis of which it can then be solved approximately for a boundless region. The boundary conditions are then particularized for diffraction by a sphere with a given radius in a homogeneous and isotropic medium, considering an electric field which outside that sphere satisfies the Helmholtz vector equation in a spherical system of coordinates. Uniqueness of the solution to such a boundary-value problem, if one exists, is established by theorem on the basis of the Cauchy-Bunyakovskiy inequality, whereupon its existence is established by demonstrating that the problem is one of the Fredholm kind. References 11.

UDC 621.371.36.029.63

Saturated Intensity Fluctuations of Radio Waves Propagating through Solar Plasma

907K0235A Gorkiy IZVESTIYA VYSSHIKH
UCHEBNIKH ZAVEDENIY: RADIOFIZIKA
in Russian Vol 33 No 2, Feb 90 pp 135-142

[Article by S.N. Rubtsov, O.I. Yakovlev, and A.I. Yefimov, Institute of Radio Engineering and Electronics, USSR Academy of Sciences]

[Abstract] Saturated intensity fluctuations of radio waves propagating through the solar plasma are analyzed on the basis of experimental data provided by "Venera-15,16" spacecrafts during 1984 explorations, a theory of

such fluctuations and mathematical models having been developed earlier on the basis of explorations of the terrestrial ionosphere. The solar plasma was sounded with decametric (32 cm) and centimetric (5 cm) radio waves skirting the sun as close as 100-2.5 solar radii. The results are evaluated in terms of asymmetry and kurtosis factors, both depending on the flicker index and on the nearest distance of the radio beam to the sun. On this basis are then calculated the frequency spectra and the autocorrelation functions of these fluctuations. They indicate that random focusing occurs when 32 cm radio waves approach the sun within 13-16 solar radii and intensity spikes appear when 5 cm radio waves approach the sun within 3-7 solar radii. The spectra of these fluctuations indicate a maximum spectral density within the 0.1-0.3 Hz frequency range, in close agreement with the theory. Figures 6; tables 1; references 15.

UDC 550.388.2

Phase Perturbation in Strong Radio Waves Reflected by Ionospheric F-Layer

907K0235B Gorkiy IZVESTIYA VYSSHIKH
UCHEBNIKH ZAVEDENIY: RADIOFIZIKA
in Russian Vol 33 No 2, Feb 90 pp 143-149

[Article by V.V. Belikovich, Ye.A. Benediktov, V.A. Zyuzin, G.P. Komrakov, M.Yu. Krasilnikov, A.V. Prokofyev, and A.V. Tolmacheva, Scientific Research Institute of Radio Physics]

[Abstract] An experimental study of strong radio waves reflected by the ionospheric F-layer was made with the aid of sounding radio waves in December 1986, November 1987, and December 1988, at two radio frequencies: 4.785 GHz and 5.828 GHz. The apparatus of the "Sura" facility included a cophasal antenna array for reception of signals with two mutually orthogonal linear polarizations (12 dipoles for each polarization), a phase shifter gang for resolution of two circular polarizations corresponding to ordinary and extraordinary magnetoionic wave components respectively, a selective receiver having a bandwidth of approximately 40 kHz, followed by a phase detector and an amplitude detector. The data reveal fast phase variations in the strong ordinary wave component upon impingement of a strong radio wave on the F-layer and intense signal scattering near the mirror reflection level, evidently owing to formation of prominent artificial periodic inhomogeneities in the field of a strong standing radio wave as the strictional force is compounded by strictional parametric instability. Figures 2; references 13.

UDC 550.388.1

Methodological Accuracy of Signal Delay Readings during Radio Sounding of Ionosphere

907K0235C Gorkiy IZVESTIYA VYSSHIKH
UCHEBNIKH ZAVEDENIY: RADIOFIZIKA
in Russian Vol 33 No 2, Feb 90 pp 150-154

[Article by Yu.K. Kalinin, V.Ye. Kunitsyn, and L.L. Rozhdestvenskaya, Moscow State University]

[Abstract] Use of solitary digital ion probes for radio sounding of the ionosphere along oblique paths is ana-

lyzed for accuracy of signal group delay readings, subsequent calculation of the three-dimensional electron concentration distribution in the ionosphere not being possible on the basis of these readings but being done along smooth profiles of a laminar ionosphere. The effect of three-dimensional inhomogeneities associated with non-uniformity of the electron concentration on readings of the group delay of signals from an ion probe is evaluated in the approximation of an isotropic ionosphere and scalar radio waves, namely radio waves whose electric field satisfies the Helmholtz equation. The dispersion relation is established at the high-frequency limit (wave number $k \rightarrow \infty$) by the stationary phase method, first assuming local uniformity of three-dimensional electron concentration fluctuations within an ionospheric layer and then considering a thin statistically homogeneous layer with large-scale inhomogeneities. The results of analysis and calculations indicate that measuring the signal group paths in the ionosphere accurately within the 1-5 km Fresnel radius is adequate for reconstruction of the regular ionosphere profile but not for determining the statistical characteristics of three-dimensional ionospheric inhomogeneities, which requires measuring the variations of those paths. References 4.

UDC 551.501.85

Characteristics of Wind Field in Clouds Based on Readings of Noncoherent Radar

907K0235D Gorkiy IZVESTIYA VYSSHIKH
UCHEBNIKH ZAVEDENIY: RADIOFIZIKA
in Russian Vol 33 No 2, Feb 90 pp 164-169

[Article by V.M. Melnikov, Main Geophysical Observatory]

[Abstract] Inasmuch as the two characteristics of the wind field in clouds and clusters measurable by a Doppler radar are the mean velocity of hydrometeors in the direction of the sounding radio beam and the width of the velocity spectrum of scatterers within the radar pulse range, the mean velocity of hydrometeors being simply equal to half the product of Doppler frequency shift and wavelength of the radio beam but the width of the scatterer velocity spectrum being equal to half the product of that wavelength and the spectrum broadening. Measurement of that spectrum broadening with a noncoherent radar is considered, the four independent and thus additive causes of this effect being turbulence, vertical wind gradient, gravity precipitation of particles, and radio beam width. Measurement of these four spectrum broadening components involves estimation of their standard deviations, calculation of the signal correlation coefficient, and determination of the frequency of signal mean-value crossovers as well as of the mean modulus of the difference between successive pulses. Such measurements were made in the Leningrad region with automated instruments including Fourier analyzers. An evaluation of data pertaining to selected clouds, assuming a Gaussian ergodic echo signal, reveal how the radar output signal indicating the mean difference between wind velocities depends on the width of the scatterer velocity spectrum and on the echo signal power correlation coefficient. It thus is feasible, by use of "outer"

coherence, to measure the difference between wind velocities without measuring the width of the scatter velocity spectrum. Figures 4; references 9.

UDC 533.933

Magnetic Instability of Nonhomogeneous Plasma in Field of Strong Electromagnetic Wave

907K0235E Gorkiy IZVESTIYA VYSSHIKH
UCHEBNIKH ZAVEDENIY: RADIOFIZIKA
in Russian Vol 33 No 2, Feb 90 pp 170-176

[Article by A.I. Alber, A.A. Zharov, T.M. Zaboronkova, I.G. Kondratyev, and Z.N. Krotova, Scientific Research Institute of Radiophysics]

[Abstract] Magnetic instability of a weakly nonhomogeneous plasma in the field of a strong incident high-frequency electromagnetic wave is considered, particularly the hydrodynamic diffusion stage of this instability characterized by a mean free path of electrons much shorter than the length of the electromagnetic wave in the plasma region coinciding with the region where the amplitude of the electric field component becomes nonuniform as plasma resonance is approached. The plasma is assumed to be a plane-laminar one with a linear electron concentration profile. The wave is assumed to be a normally incident monochromatic one. The vector equation describing the quasi-static magnetic field generated by such a wave in such a plasma involves the frequency of electron-ion collisions and a nonlinear current, the latter calculated by the Hertz method including only ten moments. The problem of instability evolution is solved for a quasi-static magnetic field orthogonal to both the electron concentration gradient and to the electric field component of the incident wave, in the approximation of a slowly varying amplitude of the longitudinal wave field component and a high electron-ion collision frequency. Small-scale perturbations of the quasi-static magnetic field during instability evolution are calculated on the basis of an analytical solution to the corresponding system of equations. Analysis of large-scale perturbations requires a numerical solution, upon regularization of the problem by phenomenological accounting for the fact that interaction of the current and the quasi-electrostatic field is slightly delocalized. These perturbations are found to be still relatively small-scale ones within the region of negative diffusion. Figures 4; references 7.

UDC 621.396.677

Diffraction of Electromagnetic Waves by Thin Shields of Variable Configuration

907K0235F Gorkiy IZVESTIYA VYSSHIKH
UCHEBNIKH ZAVEDENIY: RADIOFIZIKA
in Russian Vol 33 No 2, Feb 90 pp 226-230

[Article by V.V. Martsafey, I.G. Shvayko, and G.F. Tsahimov, Odessa Institute of Electrical Communications Engineering]

[Abstract] The problem of diffraction of electromagnetic waves is solved by a time-efficient new method for the

design of antenna arrays with variable configuration. The problem is assumed to be a two-dimensional one, corresponding to diffraction by a thin shield, and reducible to the Fredholm integral equation of first or second kind. The method of solution, following reduction of the integral equation to a well-conditioned system of linear algebraic equations, involves collocation with piecewise-uniform interpolation. Deletion of an n -th row and an n -th column from the original $M \times N$ matrix yields a new matrix for a shield with a hole the location of which corresponds to the n -th element of that original matrix. Subsequent deletions of rows and columns will correspond to insertion of additional holes or expansion of existing ones, shortening and narrowing the shield being effected by deletion of peripheral columns and rows. The time required for computing a new matrix is much shorter than that required for computing the original one, inasmuch as the algorithms are the same and can be executed simultaneously. The method is very expedient for estimating the dependence of the antenna performance characteristics on the size and the location of gaps between mirror segments of a reflector antenna, for design of multislot antennas mounted on any kind of surface, design of multislot shields for optimization of electromagnetic apparatus, and for shaping the radiation pattern of an aperture by varying the flange. The procedure is demonstrated on diffraction of E-polarized or H-polarized waves emerging from the open end of a plane waveguide of finite length with a variable-length plane solid flange, a "perforated" solid flange, or a laminated flange, assuming that the waveguide has been excited by a current filament. The solution by this method of a model diffraction problem, namely diffraction of a normally incident electromagnetic wave by and ideally conducting ribbon, is compared with the solution of this problem on the basis of the same integral equation without extraction of the root singularity and with its solution by separation of variables in an elliptical system of coordinates. Calculations of the directive gain in both principal and reverse directions for each kind of flange are found to be made most economically and with satisfactory accuracy even the corner points by the proposed method. Figures 5; references 8.

UDC 538.574.6

Peculiarities Characterizing Reflection of Spherical Electromagnetic Wave by Anisotropic Dielectric Medium

907K0235G Gorkiy IZVESTIYA VYSSHIKH
UCHEBNIKH ZAVEDENIY: RADIOFIZIKA
in Russian Vol 33 No 2, Feb 90 pp 249-252

[Article by F.G. Bass, A.A. Bulgakov, and S.I. Khankina, Institute of Radiophysics and Electronics, USSR Academy of Sciences]

[Abstract] Reflection of a spherical electromagnetic wave by a solid anisotropic dielectric medium is analyzed and specifically the side waves which emerge when the angle of incidence is larger than the critical one, these side waves propagating not only through the medium in which both the point source of such a wave and the receiver are located but also partly through that dielectric medium. The medium containing the source

and the receiver is assumed to be a homogeneous dielectric one in the half-space $y > 0$. The dielectric reflector medium is assumed to be a uniaxial crystal with its optical axis in the plane of the interface perpendicular to the z -axis. In accordance with the theory of reflection and refraction, the field of the incident spherical wave is represented as the sum of two plane waves polarized so that $E_y = 0$ and $H_y = 0$ respectively. Both an ordinary wave with $\text{div } E = 0$ and an extraordinary wave with $\text{div } D = 0$ can be found to propagate through the crystal, with $E_z = 0$ and $H_z = 0$ respectively. There remains then only an E_x component. In the ambient medium this component represents superposition of the incident wave and the reflected one. In the crystal this component represents superposition of the ordinary wave and the extraordinary one. On the basis of this model, with each wave described by a surface integral and with the appropriate expression for the reflection coefficient, the amplitudes of both side waves have been calculated numerically as functions of the azimuth angle in positively uniaxial crystals ($m^2 > n^2$) as in GaAs-TiO₂ and AgCl-SiO₂ systems or in negatively uniaxial crystals ($m^2 < n^2 < 1$) as in CsBr-NaNO₃ and KRS6-(NaNO₃, TiCl, TlBr) systems. The results yield information about the crystallographic axes of such crystals, which accordingly can be determined from measurement of both ordinary and extraordinary side waves. Figures 2; references 6.

UDC 621.396.677

Numerical Analysis of Compact Polygon for Antenna Radiation Pattern Measurement with Collimator

907K0235H Gorkiy IZVESTIYA VYSSHIKH
UCHEBNIKH ZAVEDENIY: RADIOFIZIKA
in Russian Vol 33 No 2, Feb 90 pp 253-255

[Article by E.M. Inspektorov and G.I. Rusetskaya, Gomel State University]

[Abstract] Measurement of antenna radiation patterns by the collimator method is considered, which involves a numerical analysis of a compact polygon. The collimator is formed by the antenna, typically a reflector antenna having the shape of a segment of a parabolic cylinder rotating about a pivot at the center point on its surface, and mirror which is also a segment of a parabolic cylinder. The exciter, the third element of the polygon facing the mirror, represents a cophasal array of electric current filaments with the phase center at the focus of that mirror. Both antenna and mirror have rounded edges and both are assumed to be ideally conducting, the mirror being much wider than the antenna. As the radiation pattern of such an antenna is regarded the angular distribution of the field produced at the focus of the parabolic antenna by currents induced on the mirror. The currents induced on both antenna and mirror surfaces by an external source such as the exciter are determined theoretically from the solution to the corresponding Fredholm integral equation of the second kind

and the E_z component of the field at the observation point is then determined accordingly. Numerical calculations based on measurements in the polygon will be sufficiently accurate when the function describing the radiation pattern of the antenna is constant over the antenna aperture angle and zero on both sides beyond

that angle, when the exciter is exactly matched to the feeder and to the ambient space, and when diffraction and shadowing by the exciter are negligible. Calculations have been made for two different antenna-mirror-exciter configurations and, for comparison, with the antenna in free space. Figures 4; references 4.

UDC 621.371.3.01

Distribution of Fluctuations of Spherical Waves in Far Field Behind Chaotically Behaving Planar Shield

907K0161A Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 35 No 1, Jan 90*
pp 12-20

[Article by S.M. Golynskiy]

[Abstract] Scattering of spherical waves by a chaotically behaving planar shield is analyzed in a plane behind the latter and parallel to it, this problem serving as a model for radiometric sounding of the ionosphere either from a spacecraft above the latter or from the surface of Earth. First is considered a spherical monochromatic wave diverging from a point source and passing through such a shield which modulates it randomly in space so as to cause fluctuations of the wave behind it. The modulation pattern is determined by the transmittance of the shield, a function whose modulus and argument (coordinates in any plane of observation to the shield) characterize amplitude and phase modulation respectively. This function is assumed to have a statistically uniform distribution, namely a constant mean value equal to its modulus immediately behind the shield and zero mean fluctuations. Its fluctuation component is assumed to have cumulants and the latter, of any order, to be absolutely integrable. The asymptotic distribution of fluctuations of a diverging wave sufficiently far behind such a phase shield is found to be an approximately elliptical-normal one when the phase fluctuations of the shield are very small and the effective wave parameter is larger than 1 or a spherical-normal one when the phase fluctuations of the shield are very large and the effective wave parameter is much larger than 2. The asymptotic distribution of fluctuations of a converging spherical wave which passes through such a phase shield is found to approach a normal one from the shield to the focal point and then, as the wave again diverges, to become denormalized with increasing distance beyond that point. The author thanks V.D. Gusev for attentiveness and helpful comments. Figures 2; references 15.

UDC 523.42-852:621.396.96

Refraction of Radio Waves Sounding Polar Atmosphere of Venus

907K0161B Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 35 No 1, Jan 90*
pp 21-29

[Article by O.I. Yakovlev, V.N. Gubenko, and S.S. Matyugov]

[Abstract] Refraction of radio waves in the atmosphere above both northern and southern polar regions of Venus is analyzed on the basis of data obtained from "Jupiter-Venus" and "Venus-15,16" space probes, the refraction pattern being characterized by the altitudinal

profiles of the angle of refraction angle, of the referred refractive index, and of the refractive attenuation. The index profile appears to follow a power law with a corresponding monotonic signal attenuation below 59 km, a zone with a uniform mean vertical temperature gradient, and to become an exponential one above 59 km up to 87 km. The angle profiles above the two polar regions are found not to differ, except within the narrow 58-60 km tropopause zone most likely owing to a different variability of the atmosphere. The data are compared with those on the equatorial region and little difference is found except within that tropopause zone. The evaluation of relevant data includes altitudinal profiles of the electric field of decimetric (32 cm) radio waves, these profiles being consistent with the other results.

UDC 621.396.96:781.3

Estimating Power of Optical Probing Signal in Turbid Medium

907K0161C Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 35 No 1, Jan 90*
pp 34-38

[Article by E.V. Pikkell, V.D. Samoylov, and M.S. Chukin]

[Abstract] The power of an optical probing echo signal returning to the receiver after passage through a turbid and, therefore, scattering medium is calculated by an analytical method based on the integrodifferential equation of radiation transfer in the low-angle approximation. This power is expressed in terms of effective beam and field-of-vision radii, effective beam divergence angle, effective radii of transmitter and receiver apertures, and radius of the reflecting inhomogeneity. The expression simplifies when the inhomogeneity is smaller than the transmitter aperture and the latter is smaller than or equal to the receiver aperture. The reflection coefficient, which depends on the displacement of the inhomogeneity relative to the probing beam, is approximated as an exponential function of that displacement in a two-dimensional Cartesian system of coordinates. References 7.

UDC 621.391.01

Superresolution Limit for Reconstruction of Signals

907K0161D Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 35 No 1, Jan 90*
pp 68-87

[Article by Ye.L. Kosarev]

[Abstract] The existence of an absolute superresolution limit for reconstruction of signals which exceeds both the Rayleigh limit and the diffraction limit is established on the basis of Shannon's theorem, without restricting the signal spectrum to a finite one or the problem to a

parametric one. The problem of signal reconstruction is then solved by the maximum likelihood method and an improved version of the M.Z. Tarasko procedure for iterations in the direction close to the gradient of the logarithmic likelihood function, assuming a binomial or Poisson distribution of the readings at each individual point and a polynomial distribution of all values. The dependence of the superresolution limit on the signal-to-noise ratio has been determined on the basis of numerical experiments for either two or three narrow lines with Gaussian profiles and four different kinds of kernel $K(x,y)$ appearing in the linear integral equation of the first kind and representing the instrument characteristic:

$$K(\tau) = e^{-\tau^2},$$

$$K(\tau) = 1/(1 + \tau^2),$$

$$K(\tau) = \sin \tau / \tau,$$

$$K(\tau) = (\sin \tau / \tau)^2,$$

where $\tau = (x-y)/D$.

This method of signal reconstruction is further considered for processing readings of nuclear magnetic resonance in heavy-fermion superconductors such as UBe_{13} . In conclusion, superresolution is evaluated from the standpoint of the uncertainty principle. The author thanks L.A. Vaynshteyn (deceased) and K.Sh. Zigan-girov for interest and critical comments, Ye.R. Podolyak and V.I. Gelfgat for assistance in running the signal reconstruction programs on a computer. Figures 9; references 40.

UDC 537.533.3

Spatial and Time-of-Flight Focusing in Electrostatic Lens with Two Planes of Symmetry

907K0161E Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 35 No 1, Jan 90 pp 125-133

[Article by S.B. Bimurzayev and Ye.M. Yakushev]

[Abstract] Characteristics of electrostatic lenses with two planes of symmetry used for focusing transient fluxes of charged particles in instruments like time-of-flight mass spectrometers is analyzed, considering that the performance of these instruments will be influenced by time-of-flight aberrations and spatial aberrations in such a lens. Flight calculations are made for an electron moving from an initial plane $z = a$ to an arbitrary other plane $z = b$ in a system of rectangular coordinates x_1, x_2, z where the z -axis is collinear with the axis of symmetry of the electrostatic field and planes x_1z, x_2z are its planes of symmetry. Its time of flight in such a system is calculated as the sum of its time of flight along the z -axis plus two terms of a power series representing up to N -th order integral chromatic aberration, two terms of a power

series representing second-order geometrical aberration, and a two terms of a power series representing third-order mixed aberration. These calculations are based on the equations of projections of paraxial trajectories in an electrostatic field with a quadrupole component and yield the coefficients characterizing those various modes of time-of-flight aberration. References 5.

UDC 535.853.22:534.29

Collinear Acoustooptical Diffraction in Two Crystals

907K0161F Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 35 No 1, Jan 90 pp 175-178

[Article by V.G. Zakharov and V.N. Parygin]

[Abstract] Replacement of a single "long" crystal with two "short" ones for acoustooptic interaction in devices such as an acoustooptic filter is considered, operation of these devices being based on the phenomenon of collinear acoustooptical diffraction in an anisotropic medium. Here light passes from one crystal to the next while the acoustic wave in the second crystal originates from an independent second piezoelectric transducer, both transducers being excited by a common oscillator but a phase shifter being placed between the oscillator and the second transducer so that an additional phase shift can be imparted to the signal entering the second crystal and thus control the efficiency of conversion. The resultant divergence of sound is smaller, moreover, inasmuch as the second crystal appears as a "new" source. The performance of such a device is analyzed theoretically on the basis of a system of two short equations describing collinear diffraction of light waves by a Gaussian sound beam. The solution for one crystal, which is then replaced replaced with one of double length and with two short ones, yields for each case the dependence of the intensity of diffracted light on the product of distance traveled and light-sound synchronization index, and in the case of two crystals on the additional phase shift, also the dependence of the acoustooptic interaction pattern on the sound divergence index. A comparison of their performance on this basis under otherwise identical conditions with optimum phase matching in each indicates less blurring but a higher lateral peak with two crystals than with one crystal of double length, both schemes being almost equivalent in terms of filter bandwidth. Figures 4; references 5.

UDC 621.383.82

One-Electron Pulse and Pulse Response Characteristic of Real Photomultipliers

907K0161G Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 30 No 1, Jan 90 pp 179-181

[Article by N.B. Glukhovskaya and G.D. Petrukhin]

[Abstract] The two principal performance characteristics of real photomultipliers with some degree of nonhomo-

geneity, namely the shape of a one-electron pulse and of the transient response, are calculated for the basic scheme with at least two additional interelectrode gaps having different time constants than those of the regular dynode-dynode and dynode-anode gaps. The calculations are based on refinement of Shubnikov's and involve two convolutions, a three-dimensional one and a four-dimensional one, of exponential time-of-flight distribution functions characterizing passage of electrons through individual photomultiplier stages. The pulse current and the response current as functions of time have been calculated numerically according to this theoretical model for FEU-115 photomultiplier consisting of three nonhomogeneous stages in cascade under 112 V with an anode sensitivity of 10 A/lm. For an experimental validation of this model, both rise time of the response current and duration of the transient were measured in accordance with the applicable Standard procedure. The agreement is found to be typically within 7%. Figures 2; references 2.

UDC 621.317.794

Noise in High-Speed Superconducting Bolometers

907K0161H Moscow *RADIOTEKHNIKA I
ELEKTRONIKA in Russian Vol 35 No 1, Jan 90*
pp 182-191

[Article by A.D. Tkachenko and I.A. Khrebtov]

[Abstract] A series of high-speed superconducting bolometers has been built on a cylindrical aluminum substrates, 8 mm in diameter and 5 mm long, for an evaluation of their noise characteristics. Anodization of their surfaces produced 5-70 μm thick Al_2O_3 insulation layers on which were vacuum-deposited 30-100 nm thick Sn or Sn + Pb superconducting sensor films (critical temperature approximately 3.7 K and 4.2 K respectively) with an electrical surface resistance in the normal state varying over the 0.2-200 Ω/square range. The high-resistance sensors were produced by first vacuum-depositing an approximately 1 nm thick Au interlayer. For comparison, some bolometers were built without the insulation layer. The bolometers were placed inside a helium cryostat, with a copper block mounted to the bottom of the helium reservoir through a teflon gasket filtering out temperature fluctuations in boiling helium. Measurements covering the spectral range from 1 Hz to 100 kHz have yielded the dependence of the noise voltage and the volts-per-watt sensitivity on the bias current, on the temperature, and on the base resistance. For analysis and evaluation of the results, the low-resistance bolometers are considered and here $1/f$ -noise is identified as the principal component most likely attributable to a thermal mechanism. The high-resistance bolometers are considered next and here, too, $1/f$ -noise is identified as the principal component but attributable to a magnetic mechanism, the accompanying residual component being more likely associated with the resistive state during superconducting transition rather than with thermal flicker which should have been suppressed by the Au interlayer. Measurements have also yielded the threshold power flux ($\text{W}/\text{Hz}^{-1/2}$).

According to these experimental data, which confirm the results of theoretical calculations, the lowest noise level is found in Sn + Au bolometers with an electrical surface resistance corresponding to an approximately 0.5 and thus nearly maximum absorption coefficient. Figures 5; tables 1; references 21.

UDC 537.874.6.01

Diffraction of Surface Waves on Dielectric Plate by Metal Cylinder

907K0227A Moscow *RADIOTEKHNIKA I
ELEKTRONIKA in Russian Vol 35 No 2, Feb 90*
pp 241-251

[Article by V.I. Kalinichev and N.M. Solovyev]

[Abstract] Diffraction of surface waves traveling along a dielectric plate by a closed circular cylinder above the plate and parallel to it is analyzed for dependence of the phase shift and the dissipated power on the geometrical parameters of the structure. The problem is reduced to successive reflections of waves by the cylinder and the plate, assuming that the steady-state amplitude and phase distribution of these waves satisfies the condition of a self-consistent field. The resultant field, sum of the incident one and the scattered one, satisfies not only the Helmholtz equation everywhere outside the cylinder but also the condition of zero tangential components of the E-vector at the cylinder contour surface, and the condition of continuity of the tangential components of both E and H vectors at the dielectric-vacuum (free space) boundary. The integral equation of the second kind for the spectral density, which characterizes the amplitude and phase distribution of plane electromagnetic waves over the spectrum of a cylindrical source is formulated and then solved analytically for an E_1 -wave and for an H_1 -wave. The spectral density depends in the first case on both longitudinal and normal components of the volume current density and in the second case on its sole transverse component. With asymptotic convergence of the free term established, each integral equation is reduced to an infinite system of linear algebraic equations for the respective reflection and transmission coefficients as elements of the scattering matrix. The solution to each, existing and unique in the Hilbert l_2 -space, is obtained by the method of reduction with an a priori given accuracy. The power radiation pattern is calculated by the method of steepest descent. Numerical solutions have been obtained for a plate material with a relative dielectric permittivity of 10, an ideally conducting cylinder, and $d_0/a = 0.5$ (d_0 -minimum gap width, $2a$ -plate thickness), letting $ka = 0.455$ for an E_1 wave with a 1.4 phase lag coefficient and $ka = 0.313$ for an H_1 wave with a 2.2 phase lag coefficient ($k = \omega c$, ω -radian frequency of wave, c -speed of light). Figures 5; references 8.

UDC 537.874.6.01

Comparative Accuracy Evaluation of Numerical and Asymptotic Solutions to Problem of Diffraction of Plane Electromagnetic Wave by Periodic Surface of Ideal Conductor907K0227B Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 35 No 2, Feb 90*
pp 258-266

[Article by V.A. Korneyev, A.G. Mikheyev, Ye.Yu. Rabotnova, and A.S. Shamayev]

[Abstract] The two-dimensional Helmholtz equation for the problem of diffraction of an obliquely incident plane E-polarized or H-polarized electromagnetic wave by a periodically irregular surface (period $b = 2\pi$) of an infinitely long ideally conducting cylinder, with the plane of incidence normal to the axis of the cylinder, has been solved asymptotically in the Kirchhoff approximation and with the third expansion term added as well as numerically by the Krylov-Bogolyubov method after reduction to an integral equation of the second kind for the longitudinal field components and then to a system of algebraic equations for the constant coefficients of the characteristic functions. Both solutions have yielded the amplitudes and the phases of the complex surface currents J_E, J_H and the amplitudes of reflected waves as functions of the normal coordinate, of the angle of incidence, and of the wave number, also the backscattering coefficient at low resonance frequencies as a function of the surface rise and of the angle of incidence. The more nearly exact numerical solution was obtained for both Dirichlet and Neumann boundary conditions with wave numbers ranging from 1.5 to 7.5 and with an "energy defect" not larger than 10^{-3} . An analysis of the results indicates that refinement of Kirchhoff's asymptotic by addition of the third expansion term has not improved its accuracy. Figures 5. references 6.

UDC 621.372.85

Characteristics of Radiator Consisting of Flanged Waveguide and Metal Strip907K0227C Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 35 No 2, Feb 90*
pp 275-280

[Article by I.K. Kuzmichev and D.G. Seleznev]

[Abstract] An adjustable millimetric-wave radiator consisting of a flanged plane waveguide and a metal strip is designed by scaling down its centimetric-wave prototype and subsequent refinement to ensure adequate wideband matching to the feeder. As a specific configuration is considered one with the metal strip narrower than and symmetrically parallel to the flange at the exit end of the waveguide, the distance between them being much smaller than the radiation wavelength λ . Two coefficients representing the fractions of excitation energy transmitted beyond the strip and reflected back into the

waveguide are calculated for a narrow waveguide from the solution to a system of linear algebraic equations of the second kind for the coefficients of a series expansion, in basis functions, of the field at the mirror surface of a resonator cavity. They are calculated as functions of the distance between flange and strip over the 0-0.06 range of the distance-to-wavelength ratio, for strips whose width equals one half-wavelength and successive odd multiples thereof. The results indicate that the coupling between radiator and ambient space can be regulated by means of a strip of a certain width, namely by varying the distance of this strip from the waveguide flange, resonance on the plunger wave occurring with the strip at some distance from the flange. As the width of the strip is increased, this critical distance becomes smaller and so becomes the amplitude of the resonance. The optimum distance corresponding to maximum transmission of energy, almost all, into the ambient space has been established experimentally and found to be equal to the width of the waveguide (behind the flange) plus 0.04λ ($[g-]$ radiation wavelength). The radiation pattern is also calculated accordingly. The experiment was performed with a waveguide including a smooth reducing transition from its $3.6 \times 1.8 \text{ mm}^2$ segment to its $3.6 \times 0.12 \text{ mm}^2$ segment. The radiator was excited with waves within the 4 mm band modulated at a frequency of 1 kHz. In addition to the radiation pattern was also measured the VSWR, the latter depending on the ratio of the oscillator frequency to the frequency which corresponds to the minimum absolute value of the equivalent reflection coefficient. Adequate matching over the 0.85-1.1 range of this ratio, based on the $\text{VSWR} = 1.4$ criterion, was found to be attainable with such a radiator. Figures 5; references 4.

UDC 621.39.677.49

Optimum Adaptive Antenna Arrays for Communication and Navigation Systems907K0227D Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 35 No 2, Feb 90*
pp 335-340

[Article by Yu.I. Choni]

[Abstract] Two new alternative criteria are proposed for optimization of Applebaum adaptive antenna arrays, the conventional one being maximum generalized signal-to-(interference+noise) ratio or in equivalent terms a final steady-state weight vector w_∞ which will minimize the functional $\Phi_1(w) = P_i + \gamma[w - w_0]^2$ (P_i = effective power of interference signals including internal noise at the antenna output, w_0 = initial weight vector, γ = scale factor). The first of these criteria is minimizing the functional $\Phi_2(w) = P_i + \gamma[F - F_0]^2$ (F = instantaneous radiation pattern, F_0 = initial radiation pattern). The second of these criteria is minimizing the functional $\Phi_3(w) = P_i + \gamma[F - F_0]^2$. The results of numerical calculations based on each of these criteria indicate that, with orthogonal radiation patterns of individual array elements, design according to the first new criterion yields the same optimum vector

as well as the same functional and the same array structure as design according to the conventional criterion, while design according to the second new criterion yields a different optimum weight vector even when the radiation patterns of individual array elements are orthogonal. Figures 3; references 13.

UDC 621.391.01

Efficiency of Radio Signal Quantization

907K0227E Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 35 No 2, Feb 90* pp 349-357

[Article by I.A. Golyanitskiy]

[Abstract] Multidigital binary quantization of radio signal mixtures is analyzed and evaluated, taking into account nonlinearity of quantizers and unavoidable ambiguity of signal or interference extraction from their mixture. The classical quantization criterion is applied to three additive mixtures of a radio signal and a radio interference with amplitude and phase modulation each. In the first mixture the interference-to-signal amplitude ratio is much smaller than 1 and the signal-to-interference power ratio correspondingly much larger than 1. In the second mixture both ratios are equal to 1. In the third mixture the interference-to-signal amplitude ratio is much larger than 1 and the signal-to-interference power ratio correspondingly much smaller than 1. Binary quantization of a strong signal (first mixture) is shown to result in a large decrease of the signal-to-interference ratio, inasmuch the power of the quantized signal is almost equal to the dispersion of the quantization error, while binary quantization of a weak signal (third mixture) is shown to result in a large increase of the signal-to-interference ratio. Binary quantization is analyzed again upon introduction of quantization noise, namely the difference between quantized signal+interference mixture and quantized signal, as a new criterion of quantization efficiency pertaining to radio signals much stronger than, much weaker than, and equal to radio interference. Next is considered M-level quantization, specifically 3-level quantization, taking into account that nonstationarity of a signal+interference mixture makes the result of quantization dependent on the instant of time and on the utilized segment of the quantizer amplitude characteristic. As an example of a 3-level quantizer is considered a limiter with a $2c$ wide insensitivity zone $z(y) = 0$ between $z(y) = d$ when input $y > +c$ and $z(y) = -d$ when input $y < -c$, an asymptotically linear multidigital (r digits) one with $z(y) = -z(-y)$ and $z(t) = \text{Acos}\Phi$ output as a function of time t for $M = 2^{r-1}$ quantization levels. Its efficiency is evaluated according to another new criterion, namely the relative error $\delta = 1 - \sigma_y^2 / \sigma_z^2$ of estimating the dispersion σ_z^2 of its output process by letting σ_z^2 be proportional to $(1 + M/4)^2$ (when r is finite up to 10) and the dispersion of the input process σ_y^2 be equal to $^2(t)$. References 8.

UDC 621.391.01

Adaptive Robust Detection of Signals

907K0227F Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 35 No 2, Feb 90* pp 363-371

[Article by Yu.G. Sosulin and S.L. Salikov]

[Abstract] Synthesis of adaptive robust detectors by modification of plain robust ones is outlined, plain robust detectors based on Huber M-estimates being synthesized for operation under conditions where the probability density distribution of noise is known within a given accuracy class $P(b, q)$ ($q = \int_{-b}^{+b} p(x) dx$, $p(x)$ is symmetric and continuous on the interval $[-a, a]$ of the probability density distribution). An adaptive robust detector is synthesized specifically for deterministic signals, the procedure being analogous for such a detector of a quasi-deterministic signals with random initial phase as well as for such a detector of a coherent or noncoherent pulse sequences. In accordance with the algorithm of estimating parameter b for any fixed q , the problem is to select q so to minimize the error of that estimate. Optimum values of q have been obtained for four kinds of noise: with Weibull, Laplace, normal, and log normal probability density distributions respectively. The performance characteristics of this adaptive robust detector of deterministic signals, namely both correct-detection and false-alarm probabilities as well as the detection threshold appropriately modified so as to ensure stabilization of the false-alarm probability, are described analytically and then evaluated numerically on the basis of statistical simulation for given values of parameters b (1.28) and q (0.8), given size n of the adapting sample, and given size N of the reading sequence ($n = N = 30, 50, 100$). A comparison of these performance characteristics with those of a nonadaptive robust M-detector indicates that an adaptive one will adequately stabilize the false-alarm probability with a small n -sample already. Figures 2; references 5.

UDC 621.382.323.01

Computer Modeling of High-Speed Pulse Shapers on GaAs Field-Effect Power Transistors

907K0227G Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 35 No 2, Feb 90* pp 406-410

[Abstract] A complete large-signal equivalent circuit diagram of a subnanosecond (1-5 GHz) pulse shaping switch on a GaAs field-effect power transistor is constructed, to facilitate modeling of such a device on a Standard 1022 computer for design and performance analysis according to the universal NAP-2 program. The circuit includes not only external reactances but also internal transistor reactances, namely the nonlinearly voltage-dependent Schottky-barrier and transfer capacitances. Calculations on the basis of this model have yielded the pulseform of both the load voltage and the

gate voltage as well as the dependence of the drain switching time and of the shaper output switching time on both the load resistance and the gate resistance, also the dependence of the load current amplitude on the load resistance. The model was applied to five series AP602, two series AP603, one series AP610, one series AP910, and two series AP915 transistors produced in the USSR. On the basis of these data, which agree closely with experimental ones, can be estimated the limiting values of pulse parameters to serve as reference for the design such pulse shapers. Figures 5; tables 2; references 6.

UDC 621.372.852

Tunable Quasi-Optical Cell for 2-mm Wave Band

907K0227H Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 35 No 2, Feb 90* pp 415-420

[Article by A.A. Vertiy, S.P. Gavrilov, and V.N. Derkach]

[Abstract] A quasi-optical absorption cell for the 2-mm wave band has been designed and tested, a planar cell which consists of a layer of an absorbing medium between a metal mirror and a tunable reflector. The latter is formed by a multilayer stack of four identical metal wire gratings and correspondingly three equally wide adjustable-width gaps in free space. Each grating consists of six identical wires (straight cylinders) and is split into two wings of three symmetrically about the common axis. The period of all four gratings is the same and adjustable without limit. This cell can, in effect, be regarded as a plane-parallel Fabry-Perot interferometer operating in the reflection mode. Its optical characteristics of this cell, namely its reflection and transmission coefficients for a normally incident wave, are evaluated by treating it as a half-space containing a paramagnetic medium with a complex refractive index $N_s = n_s - jk_s$, where $n_s = k_s = 1000$ and by treatment of each grating as a layer of thickness equal to the wire diameter with complex reflection and transmission coefficients. Calculations were made for a cell with a nominal gap width d between gratings approximately equal to 3λ and a gap width regulation of about $\lambda/4$ (λ = wavelength of normally incident radiation). These calculations, made by the matrix method with the imaginary part k of the refractive index of the gratings varied over the 0-0.006 range, have yielded the dependence of its optical reflection and transmission coefficients on the dimensionless gap width change $\Delta d/\lambda$ for the various values of k . The cell was tested for the dependence of its electro-dynamical properties, namely power reflection and transmission coefficients for E-polarized 2.17-2.27 mm electromagnetic waves on the gap width change $\Delta d/\lambda$, with k also varied over the 0-0.006 range. The results reveal two critical modes: first a resonance mode corresponding to $\Delta d/\lambda$ about 0.04 with the reflection coefficient dipping from 1.0 to a moderate minimum (0.6 when $k=0.006$) and the intensity of the magnetic field component in the 20 mm thick absorbing layer rising from zero to a maximum (high sharp peak when $k=0$), then a matched mode corresponding to $\Delta d/\lambda$ about 0.26 with the reflection coefficient dipping from 1.0 to a

deep minimum (down to zero when $k=0.006$) and the intensity of the magnetic field in the absorbing layer rising from zero to a high maximum (highest when $k=0$). The cell was also used for experimental study of magnetic resonance at a frequency of the incident electromagnetic wave equal to the Larmor frequency in the resonance mode and in the matched mode, the reflection coefficient of the paramagnetic absorbing layer also dipping to a deep minimum at that frequency. Figures 4; references 5.

UDC 537.874.4.01

Development of Numerical Method for Solution of Three-Dimensional Vector Problems of Scattering

907K0227I Moscow *RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 35 No 2, Feb 90* pp 438-441

[Article by A.G. Dmitrenko and A.I. Mukomolov]

[Abstract] A modification of the method of auxiliary electromagnetic field sources is proposed for solution of three-dimensional vector problems of scattering, namely selecting an auxiliary surface inside the scatterer body which is similar to its outer surface and representing the scattered field as the sum of the fields of electric dipoles on that auxiliary surface tangential to it. The unknown dipole moments are then determined from a system of linear algebraic equations $Bp = f$ with a $2M \times 2N$ -dimensional matrix B , the boundary conditions being approximated discretely with the number of points M larger than the number of auxiliary dipoles N . A numerical pseudosolution to that system of equations is then obtained iteratively by any applicable method such as solving the system of normal equations $B^*Bp = B^*f$, expansion of that matrix B into a product $U\Sigma V$ product of two unitary matrices U, V and a diagonal one Σ containing its singular values ($p = V^* \Sigma^{-1} U^* f$), or minimization of the functional $\Phi = \|Bp - f\|^2$ (norm squared of the error of that system of linear algebraic equations). As a practical example is considered scattering of a plane electromagnetic wave by a triaxial ellipsoid, the system of normal algebraic equations for this problem having been solved numerically by the Gauss method, the B matrix having been expanded into singular values according to the Forsythe-Malcolm-Mouler program, and the conjugate gradients method having been used for minimization of the error functional. Figures 2; references 4.

Signal Analyzers

907K0243A Moscow *PRIBORY I TEKHNIKA EKSPERIMENTA in Russian No 1, Jan 90 p 10*

[Article by A. F. Denisov, Yu. P. Donchenko, Ye. F. Kleshchevnikov, et al]

[Abstract] The center for scientific and technical creativity of youth "LUCH" offers in this commercial advertisement several instruments, including a highly sensitive analog-digital convertor performing the functions of an oscilloscope, frequency meter, voltmeter and

calculator, as well as a wide band analog-digital converter for the study of transient processes in signals with amplitudes of 10 mK to 250 V and lengths of 4 ns to 10 s, plus a cathode-ray storage oscilloscope.

CAMAC-Standard Character and Graphic Data Output Module

907K0243B Moscow *PRIBORY I TEKHNIKA*
EKSPERIMENTA in Russian No 1, Jan 90 p 18

[Article by A. D. Mruga, O. V. Minenko, A. A. Nesuck, et al]

[Abstract] This commercial advertisement offers an independent dual-processor microcomputer performing the functions of character and graphic display for connection to the CAMAC box. The module generates synchronization and RGB modulation signals for a video monitor or domestic television set and provides a set of graphic primitives as well as generation of displayed characters.

Hybrid Integrated Circuit Set for Economical Analog Information Collection Systems

907K0243C Moscow *PRIBORY I TEKHNIKA*
EKSPERIMENTA in Russian No 1, Jan 90 p 19

[Article by A. A. Zhurin, A. G. Varenik, S. A. Demidenko, et al]

[Abstract] This commercial advertisement offers a set of hybrid IC's made by hybrid-film technology in standard metal-glass bodies designed for intermediate conversion of voltages from the sensors of various physical quantities, including an integrating voltage-to-time converter, a programmable pulse signal amplifier and a low-frequency signal amplifier.

UDC 621.373

Hi-power Magnetic Nanosecond Pulse Generators

907K0243D Moscow *PRIBORY I TEKHNIKA*
EKSPERIMENTA in Russian No 1, Jan 90 p 23-36

[Article by A. N. Meshkov, Gorkiy Polytechnical Institute]

[Abstract] This review of the international (primarily Soviet) literature discusses the experience which has been gained in the development of nanosecond pulse generators containing thyristors or thyratons and magnetic ferrite compression elements. Non-linear wave devices for the generation of rectangular pulses are described and the characteristic parameters and design of generators is discussed. Methods for increasing frequency and power are analyzed. This is an area which has seen great expansion in the past 10 years, following the development of designs of very complex non-linear and wave devices, as well as powerful semiconductor devices. The transition to magnetothyristor circuits from thyratrons and discharge circuits can be compared in its

qualitative results to the transition to semiconductors in other areas of electronics. References 48: 43 Russian, 5 Western.

UDC 621.396.027.7

Transceiver for Fiber-Optic Communications Line Between Computers.

907K0243E Moscow *PRIBORY I TEKHNIKA*
EKSPERIMENTA in Russian No 1, Jan 90 p 106-109

[Article by A. B. Semenov, V. M. Vatutin, P. G. Vanichkin, et al, Moscow Institute of Electronics, USSR Academy of Sciences]

[Abstract] This article describes a simple transceiver designed to organize communications between SM and Elektronika 60 computers equipped with DLKC devices. The transmitting portion of the transceiver receives a 3-level duobinary signal with positive data and negative synch pulses, converts it to a 2-level signal, generates linear Manchester code and converts the electrical signal to an optical signal. The receiver portion converts the optical signal to an electrical signal, extracts the information and synch pulses and generates the 3-level electrical signal for further transmission. A time diagram of the operation of the decoding portion is presented. References 7: 7 Russian.

UDC 621.375.4

High-Voltage Low-Frequency Class AD Signal Amplifier

907K0243F Moscow *PRIBORY I TEKHNIKA*
EKSPERIMENTA in Russian No 1, Jan 90 p 131-133

[Article by N. A. Fefelov, V. V. Kharchenko, R. V. Chilikina, Planning-Design Bureau of Electrohydraulics, Ukrainian Academy of Sciences, Nikolayev]

[Abstract] An amplifier is described which has higher efficiency, small size and less severe cooling requirements of the output stage than a traditional class AB amplifier. A schematic diagram of the solid-state device is presented, showing the 4-transistor terminal stage, a bridge circuit; 4 identical preterminal stages, galvanically decoupled from each other in both control and power supply; and an overload protection unit for the terminal transistors, a pulse-width modulator with a feedback loop. The amplifier is intended to supply piezoceramic transducers, operating into capacitive and active loads. It produces an output voltage of at least 430 V with a power supply of 500 V, maximum load current 3 A nonlinear distortion over 2 percent, operating frequency range 0-1 kHz. References 4: 3 Russian, 1 Western.

UDC 535.853.4

Method of Measurement of Phase-Frequency Spectra by Quasioptical BWT Millimeter and Submillimeter Wave Band Spectrometer907K0243G Moscow PRIBORY I TEKHNICA
EKSPERIMENTA in Russian No 1, Jan 90 p 143-144

[Article by A. B. Latyshev, D. A. Lukyanov, I. M. Fedotova, Institute of General Physics, USSR Academy of Science]

[Abstract] This article describes a vector method for measurement of phase, the advantages of which include comparative simplicity of the equipment required, allowing the use of spectrometers not specifically designed for the measurement of phase spectra. This method can achieve high sensitivity, amounting to less than one degree, and high speed of recording of phase spectra, comparable to the speed of recording of amplitude spectra using the same equipment. The method utilizes a backward wave tube as the generator. A block diagram of the measurement system is presented. References 4: Russian.

UDC 621.383

Space-Time Characteristics of Single-Electron FEU-157 Photomultipliers with Single-Crystal GaAs-CsO Photocathode907K0243H Moscow PRIBORY I TEKHNICA
EKSPERIMENTA in Russian No 1, Jan 90 p 156-159

[Article by Ye. S. Voropay, F. A. Yermalitskiy, T. N. Palts, et al, Scientific Research Institute of Applied Physics Problems Belorussian State University, Minsk]

[Abstract] Results are presented from a study of the distribution of light sensitivity and resolution over time for various sectors of the photocathodes of an FEU-157 photomultiplier operating in single-quantum mode. It is found that within the operating portion of the photocathode in the photomultipliers studied, the nonuniformity of the light anode sensitivity is 54-98 percent, while the difference in signal transmission time is 0.76-1.9 ns. The variations in time resolution are also significant for different points on the photocathode, 0.4-1.0 ns. Diagrams of the distribution of anode sensitivity, duration of response at half-height to subnanosecond gas-discharge tube radiation and difference in time of transmission of signals for various points on the photocathodes of two specimens are presented. The response to radiation of the subnanosecond gas-discharge tube with point illumination of a selected point with minimal and uniform illumination of the central zone of the photocathode is illustrated. Work must be continued on increasing the uniformity of the electric field over the surface of the photocathode in order to achieve greater spacial homogeneity of the light and time parameters of the photomultiplier. References 11: 10 Russian, 1 Western.

Space-Time Characteristics of Single-Electron FEU-157 with Single-Crystal GaAs-CsO Photocathode907K0243I Moscow PRIBORY I TEKHNICA
EKSPERIMENTA in Russian No 1, Jan 90 pp 156-159

[Article by Ye. S. Voropay, F. A. Yermalitskiy, T. N. Palts, A. F. Chernyavskiy]

[Abstract] The distribution of light sensitivity and resolution over time are studied for various sections of the photocathode of an FEU-157 photomultiplier. Nonuniformity of photosensitivity is found to be as great as 98%, with signal transmission times varying by up to 1.9 ns. The uniformity of the response can be improved by improving the uniformity of the electrical field over the surface of the photocathode.

UDC 621.375.826

Two-wave Subnanosecond Yttrium-Aluminum Garnet Pulse Generator907K0243J Moscow PRIBORY I TEKHNICA
EKSPERIMENTA in Russian No 1, Jan 90 p 172.173

[Article by Yu. I. Babikov Kim Synir, V. Ye. Mironov, Joint Institute of Nuclear Research, Dubna]

[Abstract] A description is presented of a subnanosecond master oscillator for a laser system for excitation of plasma waves. The generator is based on a series-produced LTIPCh-8 laser. Designed for investigation of processes of excitation of plasma waves by two-frequency laser radiation, the system produces a pulse of less than 1 ns in length in trains of 3 or 4 pulses. The system lases at 1.0615 and 1.0641 μm . A cross-sectional diagram of the discharge unit is presented. References 5: 2 Russian, 3 Western.

UDC 536.422.4:66.047.3

Evaporator for Sputtering Large-Area Thin Films907K0243L Moscow PRIBORY I TEKHNICA
EKSPERIMENTA in Russian No 1, Jan 90 p 202

[Article by M. I. Fedorov, V. K. Maksimov, N. N. Tyukin, S. V. Maslenikov, Vologodsk Polytechnical Institute]

[Abstract] An evaporator is described for the production of thin films (0.05-05 μm) on large-area organic semiconductor substrates. The device consists of the actual evaporator, consisting of series-connected elements, plus a frame. The series connection of heating elements assures uniform heating of the substance and the frame fixes the position of the evaporators and assures structural rigidity, allowing films of about 400 square centimeters to be evaporated with thickness deviation of 2-3% over the entire surface.

UDC 621.396.629

Practical Wideband Photoreceptor Circuits

907K0243K Moscow PRIBORY I TEKHNKA
EKSPERIMENTA in Russian No 1, Jan 90 p 174-176

[Article by Ye.G. Volkov, V.A. Zhmud, Yu.P. Kononenko, A.A. Stolpovskiy, Institute of Automation and Electrometry, Siberian Division, USSR Academy of Sciences, Novosibirsk]

[Abstract] Circuits are described for highly sensitive light receivers with pass bands of at least 15 KHz and low internal noise levels. The dynamic band is expanded by several orders of magnitude by subtracting the currents of the photodiodes at the input of the first amplifier stage. The use of a low-noise operational amplifier with a repeater at its input yields a significant gain in signal/noise ratio. An operational amplifier developed by one of the authors and manufactured since 1988 using hybrid technology has a pass band of 80 MHz, a gain of 100 dB and a rise rate of 500 V/ μ s. Schematic diagrams of the devices are presented. References: 3 Russian.

UDC 53.089.68:531.787

Differential Capacitive Pressure Sensor

907K0243M Moscow PRIBORY I TEKHNKA
EKSPERIMENTA in Russian No 1, Jan 90 p 204-205

[Article by S.N. Afanasyev, V.G. Sevastyanov, A.Yu. Stefanov, et al.]

[Abstract] A differential capacitive pressure sensor has been developed allowing an increase in the accuracy of pressure measurement at high temperatures. The design is distinguished by the fact that the comparison chamber is made as a hollow cylindrical body, screen and non-moving electrode placed coaxially, made of a material with identical coefficient of linear expansion, allowing all vacuum seals and electric leads to be placed outside of the high-temperature area. A cross-sectional drawing of the device is presented. It can be used to measure saturated vapor pressure at temperatures up to 1000°C at 0-1000 Torr. References: 4 Russian.

UDC 536.521

Infrared Surface Acoustic Wave Radiometer

907K0243N Moscow PRIBORY I TEKHNKA
EKSPERIMENTA in Russian No 1, Jan 90 p 221-223

[Article by Ye.S. Avdoshin, Tula State Pedagogic Institute]

[Abstract] An infrared radiometer is described including a self-excited oscillator with surface acoustic wave element, the output signal frequency of which depends on the temperature of the object. The radiometer operates on the principle of interaction of thermal radiation with

the surface acoustic waves. The output signal varies with frequency of the object in the range of 40-150 ° C. References: 8 Russian.

UDC 621.317.757

Electrical Signal Spectrum Analyzer

907K0243O Moscow PRIBORY I TEKHNKA
EKSPERIMENTA in Russian No 1, Jan 90 p 221-223

[Article by V.I. Zhulev, V.P. Rumyantsev, Yu.M. Suslov]

[Abstract] This device is designed for determination of the spectral density of low-frequency random signal power. It is based on a method of filtration using active RC filters which can be tuned in terms of central frequency and Q. The frequency band is divided by octaves, assuring equality of relative transmission bands of the filters. The device has a parallel structure, assuring most rapid operation for fast estimation of a signal. The device is based on integrated microcircuits.

UDC 621.378.325

Pulse Shaper for Control of Electroptical Solid-State Laser Gate

907K0243P Moscow PRIBORY I TEKHNKA
EKSPERIMENTA in Russian No 1, Jan 90 p 242

[Article by A.G. Akmanov, V.I. Mikryakov, M.G. Santimirov, R.Z. Satuchin, A.G. Yamaletidinov]

[Abstract] The FIN-1 voltage pulse shaper is designed to control the electrooptical gate of a laser with negative feedback. The operation is based on digital-analog formation of the complex shape. The device allows electronic implementation of various laser operating modes. The technical characteristics of the device are briefly presented.

UDC 621.317.444

Three-component Digital Magnetometer

907K0243Q Moscow PRIBORY I TEKHNKA
EKSPERIMENTA in Russian No 1, Jan 90 p 243

[Article by Yu. D. Klimenko, V. I. Gornostayev, V. V. Potaphov]

[Abstract] This article describes a three-component digital magnetometer designed for measurement of the components of a vector of induction of constant or slowly changing magnetic fields at 0-0.1 mTl. The sensing element of the instrument is a miniature three-component ferroprobe which is placed in the center of Helmholtz coils and supplied with triangular pulses stabilized at 12.5 kHz. A photograph of the device is presented.

UDC 621.382.082.5:577.391

Automated Optical-Electronic Device for Measuring Coordinates of Laser Beam Power Center*907K0258A Moscow IZMERITELNAYA TEKNIKA in Russian No 3, Mar 90 pp 20-23*

[Article by V.A. Shangin]

[Abstract] The coordinates of the power center of a laser beam, determining the position of the beam axis, can be measured by the use of a method involving measurement of the integral characteristics of the radiation beam. The allows a measurement device to be designed which does not require the use of multiple energy receivers and avoids the error resulting from the discrete measurement field. The procedure involves generation and measurement of a signal proportional to an integral characteristic, with two integral signals obtained using two electronic channels connected to a two-segment photoreceptor used for each coordinate. Figures 2; References: 6 Russian.

UDC 531.76.:085:621.397.6

Influence of Ground-Point Location on Time Scale Matching Error in Satellite Television Channels.*907K0258B Moscow IZMERITELNAYA TEKNIKA in Russian No 3, Mar 90 pp 25-26*

[Article by Yu.D. Ivanova, Yu.A. Fedorov, L.S. Yunoshev]

[Abstract] A previous study discussed synchronization systems in which the results of reception of time signals at the transmitting point and two reference points were used to compute the coordinates of the satellite at the moment when it relayed the signals, which can then be used to determine the time delay at any synchronized point. Continuing these studies, the authors suggest a simple method for estimating the error component of scale matching as a function of the mutual location of the synchronized point, the reference points and the satellite with known time scale synchronization error at the reference points. This allows the creation of a highly effective time scale matching system for television satellite channels with an error on the order of 100 ns for regular matching of standards using existing hardware and communication channels. Figures 2; References 5: 4 Russian, 1 Western.

UDC 621.396.67.012.12

Improvement of Accuracy Characteristics of Measuring Scanners for Determination of Antenna Characteristics.*907K0258C Moscow IZMERITELNAYA TEKNIKA in Russian No 3, Mar 90 pp 43-45*

[Article by R.I. Rumyantsev]

[Abstract] A previous study analyzed the design of a planar scanner made of a radio-absorbing material to

decrease the strength of signals reflected from its metal parts. The scanner contains two telescoping sets of cylindrical fittings of the radio-absorbing material for the horizontal and vertical guides of the scanner, allowing the probe to be moved in the scanning plane. Precise estimation of the signals reflected by the scanner is a very difficult task. This article generates such an estimate based on the effective scattering surface of the scanner. The effective scattering surface of the design suggested in the previous article is compared to that of a design consisting of sheets of radio-absorbing material installed before the scanner. Calculated results are compared with experimental data indicating that the new design decreases the effective scattering surface of the scanner by several orders of magnitude. The use of the new design with telescopic covers decreases the strength of signals reflected by the scanner and thus increases the accuracy of measurement of field characteristics in the antenna aperture. Figures 2; References 4: 3 Russian, 1 Western.

UDC 621.317.729.3

Active Dipole Antennas for Measurement of Radio Noise Field Intensity in the Near Field.*907K0258D Moscow IZMERITELNAYA TEKNIKA in Russian No 3, Mar 90 pp 45-46*

[Article by L.A. Mikhalev]

[Abstract] The designs and parameters of active dipole antennas for measurement of radio noise electric field intensity in the near field are described. An active impedance convertor was used, consisting of a differential amplifier stage with crossed feedback transformer. The use of the crossed negative feedback transformer assured high suppression of synphase signal components, low level of combination components in the output signal, high input impedance and the required output impedance to match the antenna with the feed. As examples of use of the system, active dipole antennas were designed and produced for the 0.01-1000 MHz band. Figure 1; References: 3 Russian.

UDC 502.7:531.708

Metrologic Support of Ocean Hydrophysical Research*907K0258E Moscow IZMERITELNAYA TEKNIKA in Russian No 3, Mar 90 pp 60-61*

[Article by I.F. Shishkin, I.Ye. Ushakov]

[Abstract] The program of the "Ocean" State Committee on Science and Technology for 1986-2000 calls for the development of the scientific, technical, organizational and legal foundation of metrologic support for research in the ocean. The practical metrologic activity must be adapted to the specifics of measurement at sea. The

multivariate nature of the object of research must be considered. The organizational basis of metrologic support is the National Metrologic Service. Measurements are mostly performed using non-standardized measurement equipment, manufactured as individual units or in small batches. The resultant reduction in state supervision has not been compensated by any increase in

departmental monitoring. It is therefore very important to give marine metrologic regions the status of state regions, thus including them in the State Metrologic Service. The global nature of oceanographic research requires close international cooperation and the development of the corresponding international legal documents.

The VL10U Electric Train: Electrical Circuit Troubleshooting

907K0182A Moscow ELEKTRICHESKAYA I
TEPLOVOZNAYA TYAGA in Russian No 2, Feb 90
pp 19-22

[Article by V.S. Artsybashev, A.V. Orlov]

[Abstract] This is a continuation in a series of articles devoted to the service and maintenance of the VL10U electric train. This article discusses fault localization and troubleshooting of electrical circuitry including the low-voltage current pick-off circuits, failures in the low-voltage circuits of auxiliary equipment, failures in the motor compressor control circuitry, faults in the BB-1 low-voltage network, and first position network failures. In addition to various fault localization and troubleshooting procedures, the article provides step-by-step instructions for troubleshooting and repair operations of these and other equipment.

The XXXVI International Exhibition-Competition

907K0182B Moscow ELEKTRICHESKAYA I
TEPLOVOZNAYA TYAGA in Russian No 2, Feb 90
p 44

[Article by S.L. Dovgillo]

[Abstract] This study reports the events at the XXXVI International Model Railroad Exhibition-Competition Sponsored by the Brno (Czechoslovakian Soviet Socialist Republic) Model Railroad Club. Model railroad enthusiasts from Hungary, the German Democratic Republic, Poland, the USSR, and Czechoslovakia participated in the competition. More than 150 papers were presented to the international judges. These include operating rolling stock models from steam-driven engines through modern electric and diesel locomotives. The twelve-member judge panel reviewed each model and prototype in 14 categories and subcategories. Forty-four exhibits were awarded prizes.

Analysis and Outlook for Reducing Accident Rate

907k0312A Moscow ELEKTRICHESKAYA I
TEPLOVOZNAYA TYAGA in Russian No 6, Jun 90
pp 2-4

[Article by B.N. Zimting, ETT correspondent]

[Abstract] Chairman of the Locomotive Teams and Locomotives Management Department at the USSR Ministry of Railroads A. M Krivnoy discussed the causes of some industry failures with an ETT correspondent. In 1989, the volume of shipments was 99.1% of target, labor productivity rose 1.1% vs. a target of 5.7%, operating cost overruns reached 79 million rubles, first quarter 1990 targets were not met, and the safety record did not improve over 1988: there were 12 crashes resulting in two deaths and a loss of 2.4 million rubles. Mr. Zimting described the circumstances of some accidents and their

possible causes, primarily poor maintenance and lax discipline; he specifically singled out long working hours, excessive overtime, and the lack of basic amenities. He expects that implementation of computers, automatic safety control systems, and new management methods will improve railroad safety.

UDC 621.336.332.004.5:621.337.2

ChS4 Electric Locomotive: Fixing Electrical Circuit Faults

907k0312B Moscow ELEKTRICHESKAYA I
TEPLOVOZNAYA TYAGA in Russian No 6, Jun 90
pp 14-16

[Article by Yu.N. Sokolov, V.I. Khomchik, Kiev Passenger Depot, Southwestern Railroad]

[Abstract] The most common locomotive malfunctions and ways of dealing with them are discussed. Suggestions are made for diagnosing and fixing problems in the following units: current collectors, cam switches, and contact system; traction engines and reversal circuits; acceleration circuits; piston engine air-pressure and mechanical components; piston engine control valves; deceleration circuits; automatic safety circuit breakers; interlocking system grounding; relay circuit grounding; and auxiliary motors. The suggestions are expected to be helpful to young engineers and their assistants.

Circuit Designs of the ER2T Electric Train

907k0312C Moscow ELEKTRICHESKAYA I
TEPLOVOZNAYA TYAGA in Russian No 6, Jun 90
pp 16-19

[Article by B.K. Prosvirin, Engineer-Instructor at the October Railroad Moscow Depot]

[Abstract] A fourth article in a series which began in ETT Nos. 3, 4, and 5, 1990. A general description of the design, function, and operation of the following ER2T electric locomotive components is given: control circuit power supply sources; auxiliary compressor circuits; current collector control circuits; and converter start-up circuit. To be continued in subsequent ETT issues. Figures: 7.

Circuit Designs of the 2TE10Ut Diesel Locomotive

907k0312D Moscow ELEKTRICHESKAYA I
TEPLOVOZNAYA TYAGA in Russian No 6, Jun 90
pp 20-23

[Article by V.P. Gayvoronskiy, S.N. Petrushchenko, Voroshilovgradteplovoy Production Association and Locomotive Facilities Department of the USSR Ministry of Railroads]

[Abstract] Circuit 2179.70.01.000 E3 for the new 21TE10U^u diesel locomotive whose batch production began at the Voroshilovgradteplovoy Production Association is a modified version of the TE10M locomotive's

circuit 2139.70.01.005 E3. The new double-unit locomotive, a modification of the TE10M model, has a design speed of 120 km/h and is intended for both freight and mail trains because of its electrical compressed air brakes. It is also equipped with a new GP-311BMU2 traction generator which is a modified version of the

GP-311B, enabling it to deliver up to 26 tf of traction per unit. The power circuit, diesel start-up procedures, traction generator power and cooling chamber control procedures, electrical instruments, fire alarms, and the automatic locomotive safety indication system are described in detail. To be continued. Figures: 3.

UDC 621.313.17

Efficiency of Short-Term Electromechanical Energy Converter in Circuits With Capacitive and Inductive Integrators907k0307B Kiev *TEKHNICHESKAYA ELEKTRODINAMIKA* in Russian No 3, May-Jun 90 pp 70-77

[Article by A.D. Podoltsev, Electrodynamics Institute at the Ukrainian Academy of Sciences, Kiev]

[Abstract] A simplified model of an electromechanical energy converter with a constant resistance and a variable time-dependent equivalent inductance is examined. Capacitive (YeN) and inductive (IN) integrators are used as the pulsed power supply source. A comparative analysis of these sources is made from the viewpoint of their conversion efficiency. The use of this model makes it possible to derive empirical expressions and graphic plots for estimating the energy conversion efficiency. It is shown that for YeN, the maximum efficiency is reached when the inductance variation law is linear or parabolic; in the case of IN, efficiency rises when inductance grows faster. Under practicable conditions, the use of YeN is preferable to IN since they make it possible to attain higher efficiency in converting previously stored energy into mechanical work given a linear dependence of inductance on time. References 10; Figures 5.

UDC 621.313.2-752

Magnetic Vibration in DC Motors907k0307A Kiev *TEKHNICHESKAYA ELEKTRODINAMIKA* in Russian No 3, May-Jun 90 pp 55-58

[Article by S.P. Kalinichenko, Yu.S. Kalinichenko, Science Research Institute at the Elektroyazhmash Plant, Kharkov]

[Abstract] Magnetic vibration due to the main magnetic flux fluctuations caused by the armature core serration is the worst in four-pole DC motors with a wave winding and an odd number of slots; it often hinders the development of modern heavy-duty motors. Vibrations lead to alternating forces and may cause frame resonance

oscillations. A computer analysis of the main pole permeance made for various armature positions at a 0.02 tooth step revealed the pattern of permeance fluctuations as a function of the number of slots. Several methods of decreasing magnetic vibration are discussed. Wave windings with "dead" sections are the most expedient for eliminating the cause of magnetic vibration and reducing the resulting noise; their large-scale use is recommended for modern quadripole DC motors in place of conventional wave windings since other methods of preventing magnetic vibration appear to be less efficient. References 3: 2 Russian, 1 Western; Figures 3.

UDC 621.316:681.3

Issues of Developing Efficient Procedures of Simulating Processes in Complex Electric Power Installations907k0307C Kiev *TEKHNICHESKAYA ELEKTRODINAMIKA* in Russian No 3, May-Jun 90 pp 70-77 *Issues of Developing Efficient Procedures of Simulating Processes in Complex Electric Power Installations*

[Article by V. G. Levitskiy, A. V. Kirilenko, A. F. Butkevich, Electrodynamics Institute at the Ukrainian Academy of Sciences, Kiev]

[Abstract] Raising computation efficiency, primarily the speed of algorithms for finding the solution within an acceptable time, is especially important in a wide range of process simulation problems for complex electric power systems and other entities. Numerical simulation efficiency largely depends on the method of solving the set of algebraic equations which describe steady-state (quasistationary) and transient processes, given certain assumptions and differential equation algebraization. An equation ordering algorithm which differs from known methods in that the ordering problem is solved before forming Jacobi matrices is considered. The proposed algorithms make it possible to take into account the matrix sparsity, increase computer speed, and utilize computer memory more efficiently. They also confirm their efficacy for diagnosing electrical circuits of automation systems. The software developed on the basis of these procedures is rather versatile and can be applied to systems and entities for various purposes regardless of their functions. Appendices 1; References 4; Figures 4.

UDC 621.314.2/6:537.312.62

Determination of Power Losses in Superconducting Devices

907K0250A Kiev *TEKHNICHESKAYA ELEKTRODINAMIKA* in Russian No 2, Mar 90 pp 27-32

[Article by Yu.P. Chernavskiy, A.V. Kuzmin, Electric Power Institute imeni G. M. Krzhizhanovskiy, S. V. Nepogodyev, Institute of Power Conservation Problems, Ukrainian Academy of Sciences, Kiev.]

[Abstract] A method is studied for determining thermal losses in superconducting devices by immersing a converter in a bath of liquid helium with known volume. Heat is lost in the latent heat of evaporation. By measuring the quantity of vapor formed it is possible to determine the thermal losses in the superconducting device. It must be considered that the thermal losses represent only a portion of the heat absorbed by the liquid helium. Another portion arrives through the walls of the cryostat, from power and measurement leads and from radiation. These losses represent a background level which must be subtracted. Figures 5; References 3: 1 Russian, 2 Western.

UDC 621.382.333

Local Mathematical Model of Gallium Arsenide Schottky-Gate Field Effect Transistor

907K0250B Kiev *TEKHNICHESKAYA ELEKTRODINAMIKA* in Russian No 2, Mar 90 pp 52-56

[Article by B.M. Bondarenko, S.V. Zakharova, Institute of Electrodynamics, Ukrainian Academy of Sciences, Kiev]

[Abstract] A study is made of a mathematical model of a field-effect transistor with a Schottky barrier. The model rather precisely reflects the processes occurring in the field-effect device with Gate length over 1 μm . Using the model, it is possible to compute changes in the instantaneous values of energy, drift velocity, charge-carrier concentration, electric field intensity and potential in the transistor channel with known topologic dimensions of the device. When it is necessary, static volt-ampere characteristics of the device and the parameters of the substitution circuit can be determined. The model is very simple and can be used to design circuits based on field-effect transistors with Schottky-barrier gates. Figures 4; References 3 Russian.

UDC 621.316.723.3

Variable Reactive Power Sources Based on Condenser Batteries

907K0250C Kiev *TEKHNICHESKAYA ELEKTRODINAMIKA* in Russian No 2, Mar 90 pp 63-66

[Article by V.S. Sidorov, Lvov Polytechnical Institute]

[Abstract] Studies have been recently conducted to optimize the transmission of very high AC and DC voltages by the use of thyristor compensators. This article suggests a plan allowing a battery of condensers to be used as a variable source of reactive power, showing ranges of smooth regulation of the reactive power output at 35 to 220 kV. An example is presented of selecting equipment and the results of calculations of steady operation for a reactive power source at 35 kV using a static condenser battery with an installed capacity of 36 Mvar. The battery consists of 24 series-connected type KSKG-1.05-125 condensers in four parallel branches. Figures 3; References 12 Russian.

UDC 629.79.064.5:621.355

Analysis of Requirements For Mathematical Models of Batteries For Design of Nuclear Electric Power Systems.

907K0250D Kiev *TEKHNICHESKAYA ELEKTRODINAMIKA* in Russian No 2, Mar 90 pp 78-82

[Article by A.B. Tokarev, N.B. Zhirnova, Moscow Institute of Power Engineering]

[Abstract] The design of independent nuclear power supplies requires mathematical models of the individual elements, including the primary power source, the buffer accumulator and the load. This article studies the design of nuclear power supplies and suggests mathematical models for batteries used as buffer accumulators. A universal static mathematical model for a battery is suggested. Figures 2; References 2 Russian.

600-W Power Supply for CO₂ and CO Lasers

907K0250E Kiev *TEKHNICHESKAYA ELEKTRODINAMIKA* in Russian No 2, Mar 90 p 112

[Article by A.P. Koba, V.V. Pshenichnyy,]

[Abstract] Power supplies are described for lasers with 7-14 kV excitation voltage and 10-mA discharge current, suitable for the ILGN-703, 704, and 708 lasers. Two models are supplied, for gas-discharge tubes with grounded anode or cathode. A compensation circuit based on an inverter with variable frequency and an inductive-capacity converter is used to stabilize the current. The discharge current is very stable and there is a standby operating mode allowing remote or internal switching in not over 0.02 s. The maximum switching

frequency is at least 10 Hz. Technical characteristics of the power supplies are listed.

UDC 621.31.008.004.5

Organization of Accounting for Electric Power

907K0252A Moscow PROMYSHLENNAYA
ENERGETIKA in Russian No 4, Apr 90 pp 5-6

[Article by V.I. Kiriyyenko, Tsentrorgosenergonadzor Regional Directorate, Moscow]

[Abstract] Analysis of reports on 60 examinations of the accounting system for generation, distribution, and consumption of electric power have revealed a number of problems in the organization of accounting for electric power in systems. There is a constant shortage of electric power meters. Funds for spare parts for meters cover only 10-30% of the demand, and plants manufacture low-quality spare parts, frequently quite unusable. There is a shortage of test stands and standard instruments for verification of power meters. There is a shortage of personnel and of repair equipment. Many meters in use have passed the time for maintenance and testing, and many consumers are billed on the basis of installed capacity rather than metered use of power. The requirements of the operating rules are not met in terms of metering of high-capacity power transmission lines. Automated monitoring systems have started to be put in use in various power systems around the country. A special group has been organized to coordinate operations in power systems related to improvement of accounting and monitoring of electric power. One of the tasks of this group is to monitor the organization of accounting for electric power and provide methodological and technical assistance in the improvement of accounting and monitoring of electric power use.

UDC 658.012.011.56:002.5:621.311.4

Automated System for Monitoring and Control of Enterprise Electric Power Consumption

907K0252B Moscow PROMYSHLENNAYA
ENERGETIKA in Russian No 4, Apr 90 pp 6-8

[Article by Yu.A. Kochkarev, Doctor of Technical Sciences, G.T. Oleynik, Candidate of Technical Sciences, N.S. Solovyev, A.V. Topchiy, Cherkassa Branch, Kiev Polytechnical Institute]

[Abstract] Some of the problems in the area of monitoring and management of electric power consumption at an enterprise are discussed, including the lack of cooperation between power management enterprises and power consuming enterprises, the unavailability of standard flexible plans considering the variety of equipment in use, and the lack of organizations involved in timely revisions of standard plans for specific enterprises. The introduction of automated systems for monitoring and management of electric power consumption at enterprises is therefore still proceeding at a slow pace, with 330 systems installed in the first quarter of 1989 in the

Ukraine of 717 systems which have been acquired. Several steps are suggested to speed up the process, including orientation of the automated systems not toward improvement of accounting with energy supply organizations, but rather toward separate accounting for electric power by subdivisions within the consuming enterprise; assignment of a number of supplementary functions related to the automation were simplification of management of enterprise power consumption to the automated system; development of a standard automated system design to be revised quickly to meet the conditions of a specific enterprise; development of modular information-measurement system designs to allow selection of modules for specific conditions; organization of the delivery of spare circuit board and microcircuit modules, as well as organization of measurement equipment at energy monitoring enterprises; and the transition to open-market trade of automated system elements.

UDC 621.31:665.6(571.1)

Development of Electric Power Engineering for Western Siberian Oil and Gas Complex

907K0252C Moscow PROMYSHLENNAYA
ENERGETIKA in Russian No 4, Apr 90 pp 8-11

[Article by N.Z. Pokonov, A.P. Finkel, NEFTEGAZS-PETSMONTAZHPROYET Planning-Design and Technology Institute, USSR Oil and Gas Industry Construction Ministry, Moscow, G. I. Illarionova, National Design Institute and ENERGOSETPROYEKTE Scientific Research Institute, Moscow.]

[Abstract] During the past two decades, a large electric power system has been set up in Western Siberia. At present, a plan has been developed for the prospective development of power engineering in this region through the year 2000. This plan defines the basic strategy for development of the Tyumen power system; bypassing the stage of creating territorially isolated power units with small electric power plants, move forward immediately to the creation of a large power system based on high-capacity thermal electric power plants and major 500 kV power transmission lines. The increase in electric power consumption has exceeded even the calculations of the government planning organizations. A program of equipment modernization has been developed and is now being implemented to increase the reliability and stability of the power supply system for enterprises in the oil and gas industry and the oil and gas industry construction ministry. However, it has long been known that the large synchronous motors now being installed do not fully meet the demands for dynamic stability in cases of temporary reduction in voltage. The Tyumen power system is unique in that compressors and pumping stations are driven by large synchronous motors, allowing effective regulation of the reactive power of consumers. New and economic designs of power transmission line supports, power substations and equipment have been developed for use in this area. Some 8000 km

of 220 kV power transmission lines and over 3000 km of 500 kV transmission lines are to be constructed in this area, as well as 220-500 kV reducing substations with a capacity of about 30 million kVA. Steps must be taken to improve the sophistication of equipment and intense labor in the performance of construction, installation and adjustment operations, the manufacture of equipment and structures, products and mechanisms for use in this area.

New Electric Power Equipment

907K0252D Moscow PROMYSHLENNAYA
ENERGETIKA in Russian No 4, Apr 90 p 54

[Unattributed article]

[Abstract] Brief technical descriptions and tables of characteristics are presented for new electric power equipment, including high-voltage RRZ-35/1000UZ, RRZ-35/2000 UZ breakers, type VBChE-10 vacuum 3-pole breakers, RE12 current relays and RE14 voltage relays without standard reset ratio. Names and addresses of manufacturing plants are presented.

UDC 621.311

Influence of Capacity and Location of Electric Power Plants on Power System Organizations.

907K0268A Moscow ELEKTRICHESKIYE STANTSII
in Russian No 4, Vol 25, Apr 90 pp 16-20

[Article by D. L. Faybisovich, A. N. Zeyliger, Energoset-proyekt, Scientific Research Institute of Direct Current.]

[Abstract] The development of the electric power systems of the USA and the USSR over the past fifteen years is compared. The USSR has built and plans to build considerably more very high voltage power transmission lines (500 kV and higher). This difference results from the difference in location and construction of power plants in the two countries, the concentration of production of electric power and the balance between the development of electric power plants for regional and combined power systems with respect to the growth of power system loads. The USSR has concentrated more on the construction of large hydroelectric power plants located far from major areas of power consumption. The USSR also builds larger nuclear power plants, with capacities averaging almost twice as great as in the USA. Future Soviet plans call for reduced concentration of power generating capacity, with determination of the optimal concentration of the generating facilities in consideration of economic, ecologic and social factors. References: 4 Russian.

UDC 621.311.027.89.016.35

Study of Static Stability in Combined Power System Containing 1150 kV Power Transmission Lines.

907K0268B Moscow ELEKTRICHESKIYE STANTSII
in Russian No 4, Vol 25, Apr 90 pp 21-27

[Article by D. L. Balyberdin, T. A. Gushchina, A. Kh. Yesipovich, et al, Scientific Research Institute of Direct Current.]

[Abstract] This article studies problems of assuring static stability against cumulative hunting and effectiveness of damping electromechanical oscillations in the USSR unified electric power system as the system-forming 1150 kV power transmission system is brought on line. Control facilities studied included strong-acting systems for automatic regulation of excitation for power-plant generators and regulating systems for reactive power compensation devices. The purpose was to determine whether adjustment parameters of the excitation regulating equipment can be constant for all situations, or to suggest an adaptation logic for the transition from mode to mode. The mathematical and experimental studies demonstrate that the adjustment can be constant, limiting the operating modes of the 1150 kV power transmission lines and assuring good quality damping of electromechanical oscillations. Calculation and experimental results agree well. The experiments confirm the effectiveness of the introduction of stabilization channels to the regulating structure in weakly damped systems. References: 4 Russian.

UDC 621.311.2:620.97

Crimean Experimental Solar Electric Power Plant.

907K0268C Moscow ELEKTRICHESKIYE STANTSII
in Russian No 4, Vol 25, Apr 90 pp 60-62

[Article by V. A. Dubovenko, V. S. Galushchak, A. I. Kuryatov, V. M. Markin, Crimean Electric Power Association.]

[Abstract] The Crimean experimental solar electric power plant SES-5 transmits power into the unified national Soviet power system for the first time on 25 Sep 1985. The tasks of the plant included determination of the capability for using solar energy by its conversion to electric power using the classical thermodynamic system of a thermal electric power plant, as well as the development, manufacture, fine tuning and accumulation of experience in using new types of equipment and systems for this type of solar electric power plant. The plant consists of three basic systems: the optical system, thermal electric power generating system and power output system. It is a basin-type power plant with the heat receiver mounted at some height in the center of a circular field of heliostats forming a parabolic optical system. The SES-5 plant uses 1600 GE-500 heliostats manufactured in Czechoslovakia, each measuring 5 X

5M, with their motion controlled by three SM computers. Maximum electric power output has been 5.7 MW, annual power production 250 kW · hr, continuous operating time over 10,000 hours. A Thermal accumulation system has been developed capable of generating 1.5 MW. References: 3 Russian.

UDC 621.3:62.5.001.24

Methods of Constructing the Boundaries of the Working Capacity Area of Electrotechnical Objects

907K0269A Moscow ELEKTRICHESTVO in Russian No 4, Apr 90 (manuscript received 7 Jul 1988) pp 14-19

[Article by A.V. Saushev]

[Abstract] The working capacity of an electrotechnical object is defined by a region, G, which is the intersection of the acceptable region of the set of input parameters of an object and the set of limitations on the input parameters.

The boundaries of G are used in optimization problems and the parametric synthesis of electrotechnical systems and devices, as well as quality and stability control. The effectiveness of the solution is determined by the means of constructing the boundaries of G.

This article examines a goal-oriented method of determining the boundaries of G, the parallel straight lines method, which does not have the drawbacks of the secant method. R-functions are used to simplify the algorithm to find the boundary points of G.

The parallel straight lines method can be used for any electrotechnical object for which the working conditions are defined and for which there is a link between input and output parameters. Accuracy depends only on the degree of discreteness of the varied input parameter. Figures 3; tables 1; references 10.

UDC 621.314.6:537.312.62.001.57

Experimental Model of a Three-Phase 50 Hz Cryotronic Transformer

907K0269B Moscow ELEKTRICHESTVO in Russian No 4, Apr 90 (manuscript received 25 Nov 1987) pp 55-58

[Article by Sh.I. Litidze, Doctor of Technical Sciences, V.Ye. Ignatov, I.V. Karlash, Candidates of Technical Science, and V.N. Noskov, Engineer]

[Abstract] Superconducting transformers based on cryotrons are being developed as devices to supply, regulate, and stabilize the current of multi-ampere coils of superconducting magnetic systems.

The power of cryotrons must be increased by increasing the number of phases and the frequency of the working voltage, and by using fine disperse superconducting

materials with high Debye temperatures and high dielectric permeability for the valves.

The specific resistance ρ of the superconducting material indirectly determines the power of the transformer. For cryotrons $\rho=10^{-6}-10^{-8}\Omega\text{m}$ is desirable.

The authors theoretically analyzed the electromagnetic transition processes in the three-phase cryotron. The parameters of its basic elements were determined experimentally.

Power losses were decreased and cooling was improved after heating due to resistive losses caused the cryotron to fail.

The deviation of experimental data from theoretical did not exceed 10 percent and a method was developed to evaluate the performance of the three-phase cryotrons in commutating resistance and EMF.

Figures 4; references 4: 1 Russian 3 Western.

Conference on the Transmission of Ultra-high Voltage

907K0269C Moscow ELEKTRICHESTVO in Russian No 4, Apr 90 (manuscript received) pp 84-86

[Article by I.I. Kartashev, O.A. Nikitin]

[Abstract] A conference on ultra-high voltage (UHV) power transmission was held on 25-30 September 1989 in Moscow and Kokchetav. Specialists from a number of nations attended.

In three days of round table discussions over 50 participants discussed 25 reports on the technology of UHV transmission. An important feature of the conference was a visit to the Kokchetav 1150 kV substation.

In choosing a UHV transmission scheme, many factors aside from economic ones must be considered, for example, stability, reliability, viability, ecological limitations, regional significance, and industrial capabilities.

No decision was reached on the maximum working voltage of UHV systems, but it was decided that selection of one standard level would be expedient, as well as standards for the acceptable ecological effect of UHV transmission lines.

Reports were given on new designs in AC systems, including a Soviet self-compensating high voltage line and six-phase systems.

The ideal flexible AC transmission system was discussed again at the conference. The section on AC UHV transmission lines discussed ten reports and letters.

The visit to the 1150 kV substation demonstrated the feasibility of UHV systems.

UDC 621.311.019.34.001.24

Estimation and Guarantee of Reliability of Large Power Pools

907K0283A Moscow ELEKTRICHESTVO in Russian No 5, May 90 (manuscript received 12 Oct 88) pp 1-9

[Article by L.L. Bogatyrev]

[Abstract] The steadiness of the operation of present-day large electric power systems can be maintained and the reliability of their operation can be improved only by the extensive introduction of automatic situation control systems employing computers that can adapt to emergency situations and can identify the power systems's state. The control of these systems requires the enlistment of qualitative—so-called semantic—information. The controlled system evolves over time and its structure changes, and this causes the control process itself to evolve. The control system needs to be designed on the basis of specific knowledge concerning the controlled system that reflects the basic properties of electric power systems. This article presents various methods of forming a knowledge base for a system for controlling the operating trouble states of power systems, depending on the knowledge representation language and inference algorithms used when the control system makes decisions. Also presented are methods of identifying, in the process of solving long-term planning problems, efficient control options and power system development strategies based on a set of reliability indices when the initial data are uncertain. Various decision rules are discussed, e.g., one for determining the value of the post-accident permissible power flow for a section having an 8-percent static stability margin, taking into account irregular power fluctuations when a 500-kV power transmission line is cut off. The methods of pattern recognition theory, fuzzy sets and fuzzy evidence are found to be effective for the estimation of reliability indices in real time. In the case cited, the device of fuzzy sets and fuzzy evidence is found to be adequate for the process studied when the initial data are uncertain and makes possible the control system's adaptation as the controlled system evolves. The distinction is drawn between stochastic uncertainty—caused by random factors—and linguistic uncertainty—caused by the fuzziness of the goal of the system's functioning and of the limitations placed on the system, i.e., the fuzziness of such concepts as "high," "good" and "proper." Quantitative reliability indices for electric power systems are proposed that can be used in designing power systems and solving problems of their long-range development and control. Statistical decision functions obtained by the methods of pattern recognition theory and fuzzy sets can be used effectively in estimating in real time a power system's functioning reliability. The control system's knowledge base must be formed by using a production, relational and predicate language. Figures 3; references 14 (Russian).

UDC 537.811.001.24

Electromagnetic Field of Shielded Two-Wire Line

907K0283B Moscow ELEKTRICHESTVO in Russian No 5, May 90 (manuscript received 20 Oct 86) pp 50-53

[Article by V.P. Zakharov, A.V. Kisletsov, A.V. Krivopustov and A.Yu. Mosolov]

[Abstract] The problem of the electromagnetic compatibility of a heavy-current electrophysical plant operating in the pulsed mode with the set of equipment used with it reduces to the determination of the intrinsic field generated by the plant, i.e., is equivalent to studying the shielding properties of the plant's shell in relation to internal electromagnetic pulse sources. This article presents a technique for calculating the characteristics of the magnetic field generated by a current pulse of arbitrary shape passing through a shielded two-wire line, serving as an example of a standard component of high-tension power systems. Edge effects are disregarded, resulting in a two-dimensional problem. A pair of wires is examined, at a distance of $2a$ from one another and placed in a cylindrical shield of radius R and thickness d . An expression is found for the strength of the external field, disregarding the relationship between the shielding material's permeability and the amplitude of the strength of the intrinsic acting field of the two-wire line. The intrinsic field is represented as the superposition of the strengths of the fields of concentrically arranged multipoles for current pulse durations of on the order of 10^{-9} s. The shielding factors are defined for the individual multipoles and an expression is derived for the shield's pulse response for a fixed multipole number, m . An expression is obtained for the external magnetic field strength components of a shielded two-wire line through which a current pulse of arbitrary shape is passing. A program—the MSLW program—was written that implements the system of equations presented, for the purpose of revealing the main features of the radiated field of shielded two-wire lines. Amplitude-time characteristics are presented for the magnetic field strength of such a line at the outer surface of the shield. The shield exerts a substantial influence on the amplitude and shape of the magnetic field pulse. Currents induced in the shield create fields that oppose alteration of the pulsed field of the two-wire line. The approximate analytical expressions presented for the external magnetic field strength components can be used for engineering approximation calculations. Figures 4; references 3 (Russian).

UDC 537.523.4:536.421.1.001.24

Calculation of Heating of Walls of Metal Objects Under Effect of Lightning on Them

907K0283C Moscow ELEKTRICHESTVO in Russian No 5, May 90 (manuscript received 28 Oct 88) pp 56-59

[Article by N.R. Abramov and I.P. Kuzhekin]

[Abstract] The thermal problem was solved in previous studies for the case of the effect on the walls of metal

objects of the lasting component of lightning current. Here it was assumed that there is no heat transfer between the wall and ambient air and that the current of the lasting component of the lightning does not change over time. Current amplitudes of the order of hundreds of amperes and durations of scores and hundreds of milliseconds were used in experimental verification of the calculation procedure. The present article is devoted to an analysis of the influence on the temperature change in the walls of metal objects of a high-velocity air flow and of the drop in current over time, and of the applicability of the proposed procedure for the calculation of thermal fields when the current has a duration of single numbers of milliseconds. The thermal effect of lightning on metal objects is associated mainly with the intake of energy from the region near the electrodes when lightning current passes through after the main discharge. The heat flux is assumed to be surface flux. A system of equations is presented that describes the process of the heating of a plane unbounded wall of thickness h under the effect of a heat source of radius r_0 . It is assumed that the material's thermal properties do not depend on the temperature and that the heat flux density does not depend on time current of the lightning's lasting component. An analysis is made of the influence of heat transfer on the temperature distribution, using a thin plate as an example, in which the thermal process takes place more intensely. An analysis is made of the influence of heat transfer on heating of the walls of metal objects when there is an air flow of velocity v present. It is shown that with velocities of $v = 100$ to 200 m/s heat transfer does not result in a substantial change in the wall's temperature. Even at the hottest point ($r = 0$) the temperature is lowered by only 15 percent with $v = 200$ m/s and $t = 1$ s. Calculated data show that the change in the melting radius, r_{p1} , of an object's wall over the range of durations of the constant component of the lightning's current, taking into account heat transfer between the wall and a high-velocity air flow, is insignificant with $t = 1$ s, and the disagreement is nine percent for $v = 0$ and $v = 200$ m/s. The analytical expressions obtained for the thermal fields can be used for calculating the melting of the walls of metal objects under currents of the lasting lightning component when these currents last from single numbers to hundreds of milliseconds and when the current changes over time. Figures 3; references 6 (Russian).

UDC 621.315.21

High- and Superhigh-Voltage Cables With Insulation Made of Synthetic Materials

907K0290A Moscow *ENERGETICHESKOYE STROITELSTVO* in Russian No 5, May 90 pp 55-58

[Article by A.I. Gershengorn, engineer]

[Abstract] Previously only impregnated paper insulation was used in cables for underground and submarine

high-voltage power transmission lines. The low manufacturing cost of cables with insulation made of synthetic materials such as polyvinylchloride and polyethylene quickly made them competitors of paper-insulated cables. In addition, they have the advantages of lower weight, the ability to be laid both manually and by machine, and to be laid directly in the ground without additional protection from mechanical damage; and long single-core cables can be laid without splicing. Also, their connections are more reliable and they have a smaller permissible bending radius, making it easier to lay them under cramped conditions. They have smaller power losses and can withstand short-duration overloading and considerable short-circuit current. The advantages and disadvantages and areas of application of cables having various types of synthetic insulation are contrasted and compared, and the history of their development and introduction in electric power systems in Europe, the USA and Japan is summarized. Special attention is paid to crosslinked polyethylene (XLPE)—produced by the extrusion of low-density thermoplastic polyethylene—as an insulating material for high- and superhigh-voltage cables. XLPE insulation can withstand a rise in temperature to 90°C under long-time use, and to 100-to-105 and 250°C , respectively, during overloading and short circuiting. Though an excellent insulator, even a small amount of impurities will worsen its insulating properties, it is labor-intensive to produce, and it is more flammable than ordinary polyethylene. Cables having XLPE insulation began to be used for laying high-voltage distribution cable lines in the 60s in the USA, Japan and West Europe. In 1987 in the USA, 90.1 percent of the total length of these lines had been laid with these cables. The structure of 20-kV and 187-kV XLPE-insulated cables is shown, and the concrete block used in Switzerland for running high-density polyethylene conduits through, through which, in turn, high-voltage cables are run. Reliable new extruded connecting sleeves are making it possible to construct extended cable lines for even higher voltages. Figures 4; references 14 (Western).

Metal Tower for Areas With High Wind Loads

907K0290B Moscow *ENERGETICHESKOYE STROITELSTVO* in Russian No 5, May 90 pp 75-76

[Article by Ye.A. Kruglikov, A.S. Golovchenko and B.A. Lenitskiy, engineers]

[Abstract] The design of a special intermediate tower for use in areas with high wind loads is discussed. Anchored corner poles were previously used as two-circuit intermediate poles for 330-kV aerial power transmission lines in these areas because of the lack of a unified design for these supports. Heavy footings had to be built and too much steel was used. The tower described was developed by the Ukrainian branch of Energosetproyekt [All-Union State Design and Surveying and Scientific Research Institute of Power Systems and Electric Power Networks] with the participation of the Yuzhelektrosetstroy Trust and the Donetsk High-Voltage Pole Plant. The tower is designed for the suspension of 2XAS300/39 or

2XAS400/51 wires and one or two type S-70 lightning-protection cables in areas having a maximum wind load of 800 Pa and belonging to glazed-frost zone IV and line-wire dancing zone III. The tower has four crossarms, and the distance to the ground from the point where the wires are attached to the bottom crossarm is 20 meters. The bolt-construction tower has a rectangular cross section in plan and measures 8 x 6 with an overall height of 26 m, or 6.3 x 4.6 m with an overall height of 20 m. Its principal structural members are made of galvanized rolled angle stock. Standard precast reinforced concrete footings are used to fasten the tower to the ground. The new type A2M towers were used for the first time in a 330-kV 23-km aerial line. They can also be used in 220-kV aerial lines being constructed in areas with high wind loads, such as in the Far East. Figures 1.

New Design of Footing for Steel Aerial Line Poles

907K0290C Moscow *ENERGETICHESKOYE*
STROITELSTVO in Russian No 5, May 90 pp 76-77

[Article by N.S. Milykh, engineer]

[Abstract] The supporting capacity and deformability of the base of footings installed in earth with the earth's structure undisturbed are higher than for footings placed in a pocket in a ditch that has been backfilled. The main difficulty in installing a precast reinforced concrete footing in a drilled hole is making the connection between the footing and the undisturbed earth. The design of a pile footing that solves this problem is

described in this article. The stem of the footing is square in cross section. Four main and four additional hinged blades connected to the footing and to one another by means of links are located at the bottom of the stem at a spread heel that is round in cross section. In assembled form the blades encompass the footing along the perimeter of the drilled hole. There are notches in the lateral edges of the main blades. The free ends of each pair of additional blades are furnished with stops that can enter the notches of the respective adjoining main blades. The stops restrict the movement of the additional blades in the notches of the main blades. There are metal insertion parts installed near the heel at the bottom of the stem that have ears rigidly connected to them. There is a chamfer on the inside of the ears with which the lower parts of the main blades engage. The ends of pull rods designed for adjusting the blades' position and withdrawing the piles from the hole, when necessary, are attached to the main blades. There are prongs at the bottom of the edges of the main blades. The collapsible blades are raised before the pile footing is placed into the drilled hole, and the footing is lowered into the hole without disturbing the earth's structure. Then the blades are pressed into the earth by means of a device that has the shape of a tubular beam. The hole is then filled with a sand-and-gravel mixture that is tamped layer by layer. The result is a reliable connection to undisturbed earth. The main blades are fastened so that in the working position they engage with the footing and absorb the alternating loads acting on it. Figures 1.

New Ceramic Element Converts Gaseous Fuel Energy Into Electrical Energy

907K0292 Moscow *NAUKA V SSSR in Russian* No 3, May-Jun 90 pp 55-56

[Article by I.A. Zudov]

[Abstract] Scientists at the Institute of Electrochemistry of the Urals Division of the USSR Academy of Sciences have developed a ceramic element which converts the electrical energy of a gaseous fuel directly into electrical energy with an efficiency of up to 55-60 percent. At present the experimental model can power only a 100-W light bulb.

Specially prepared natural gas and air pass through channels in the element. Oxygen in the air oxidizes the hydrogen and carbon monoxide, and the liberated energy is converted to electricity. The by-products are nitrogen, water vapor, and carbon dioxide.

The elements are made of a solid solution of oxides of metals such as yttrium, scandium, and zirconium. Vacancies of oxygen ions are formed in the solution. Oxygen can migrate along the nodes of the crystal lattice, which gives the ceramic its unusual properties. Sensors in the element are used to monitor combustion so that it can be regulated and made more efficient.

Prospects for the use of this new technology in automobile engines and power engineering are discussed.

UDC 666.189.2:535

Correction to Abel Integral Evaluation for Interpretation of Polarization Interferometry Data on Fibers

907K0223A Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 68 No 2, Feb 90 pp 442-446

[Article by I.K. Nekrasov]

[Abstract] Polarization interferometry of highly birefringent optical fibers is considered, interpretation of interferograms requiring evaluation of the Abel integral. A correction to this integral is also needed, however, because at the fiber-coating interface the longitudinal refractive index and thus also the difference between this index and the transverse one are actually lower. The correction is demonstrated on interferograms of double refraction by polymer fibers, poly-paraphenylene terephthalamide and polyamidobenzimidazole ones, taken under a BIOLAR microscope (made in Poland). This microscope had a Wollaston prism built in for regulation of image doubling so that differential as well as integral interferograms could be viewed. It has been found that the fringe displacement is smaller than estimated due to bending of light rays at the fiber surface, due to birefringence at the fiber surface, and due to an index gradient inside the fiber. The correction is applying Tikhonov's regularization method to this ill-posed problem, the effect of an index gradient being best included according to the Iga theory (1977) and the effect of surface birefringence not being critical. The author thanks B.I. Molochnikov and L.N. Tsvetkov at the State Institute of Optics imeni S.I. Vavilov for supplying the immersion fluid for coating the fibers. Figures 2; references 13.

UDC 621.372.8:535

Waveguide Modes in Divergent Waveguide Excited by Linear Source

907K0223B Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 68 No 2, Feb 90 pp 447-451

[Article by A.S. Starkov]

[Abstract] Excitation of a divergent waveguide between two media by a linear point source near the critical cross-section is considered, the critical cross-section being the one where the thickness of the waveguide layer is sufficiently small for cutoff. The problem of waveguide modes in such a configuration is solved by the Born-Wolf method, with both E and H fields expressed through a scalar function u which in any refractive medium satisfies the equation $(\Delta + k^2 n^2)u = -\delta(x-x_1)\delta(z-z_1)$ (Δ = Laplace operator; x_1, z_1 = coordinates of the excitation source in rectangular Cartesian system of coordinates x, z) and the condition of continuity of its tangential components at the boundaries between media. The thickness h of the waveguide layer is assumed to be a slowly increasing smooth function of the x -coordinate so that the problem with a small parameter $p = \max[h](x) \ll 1$ can be solved by asymptotic expansion with the principal term in the approximate solution for a layer of

uniform thickness as reference. Expressions are obtained on this basis describing the field amplitudes of waveguide modes and the critical layer thickness for each mode at which its amplitude becomes zero. Local asymptotic expansion within the vicinity of a critical cross-section yields the size of the region within which significant transformation of an incident wave takes place, buildup of the corresponding mode being described by a special function. Figures 2; references 6.

UDC 534.522:535.345.6

Wide-Aperture Acoustooptic Filter for Intermediate Infrared Range of Spectrum

907K0223C Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 68 No 2, Feb 90 pp 452-457

[Article by V.B. Voloshinov and O.V. Mironov]

[Abstract] A wide-aperture acoustooptic filter for the intermediate infrared range of the spectrum is described, such a filter necessarily being a wideband one. The filter, with a specially cut highly anisotropic paratellurite TeO_2 single crystal as acoustooptic cell and with an X-cut LiNbO_3 single crystal as piezoelectric transducer, has a 52° aperture angle and a high spectral resolving power. Normal incidence on the front face of the filter corresponds to a 38.1° Bragg angle. The transducer induces in the cell an ultrasonic acoustic shear mode whose vector makes an 18.9° angle with the $[110]$ axis of the latter and a 57° angle with the radiation vector. The front face and the rear face of the filter are not parallel but at a 9.5° angle to each other. The design and performance analysis of this filter is based on theoretical relations and experimental data, the latter pertaining to the dependence of its diffraction efficiency on the angle of radiation incidence and on the frequency of the ultrasound. The angle of radiation incidence was measured in the $(1-11)$ plane from the front face (θ) and in the (001) plane from the front face (θ^*), the frequency f of ultrasound in the respective plane being referred to correspondingly. The diffraction efficiency was measured as a function of the angle of incidence over the $\theta = 45-135^\circ$ range and the $\theta^* = 70-110^\circ$ range respectively, with the frequency of the ultrasound varied over the 39.85-41.20 MHz range. The data fit on a family of single-peak narrow-band and double-peak wide-band curves depending on the frequency of the ultrasound. On the basis of these curves have been calculated θ - f curves on which the angles of incidence for maximum diffraction efficiency can be read. Most relevant to design of a wide-band filter are the double-peak efficiency curves and frequencies of the ultrasound yielding such curves, the required filter aperture being equal to the difference between the angles of incidence which correspond to the two not necessarily equal maxima of diffraction efficiency. The maximum number of a filtered image resolvable according to the Rayleigh criterion is equal to one half the product of angular and linear filter apertures divided by the radiation wavelength, the linear aperture being equal to the dimension of the sound column in the reference $(1-11)$ or (011) plane. The authors thank I.P. Ponomarev and V.Ya. Molchanov for producing the acoustooptic cell. Figures 4; references 7.

UDC 621.382

Functional Microelectronic Devices Based On Superconducting Quantum Interferometers907K0295A Moscow MIKROELEKTRONIKA
in Russian Vol 19 No 3, May 90 (manuscript received
20 Feb 1989) pp 221-231

[Article by A.A. Zubkov, V.I. Makhov, A.N. Samus]

[Abstract] The use of a superconducting quantum interferometer (SQUID) in logic circuits provides speeds on the order of tens of picoseconds and low energy scattering.

The SQUID is a superconducting circuit containing one or more Josephson contacts regulated by clock signals from a magnetic flux. The contents of one interferometer acting as memory is read by another. A logical 1 indicates the capture of a quantum of magnetic flux.

The memory was numerically modeled, and it was found that when parameters are optimized, a record-read cycle can be reduced to less than 300 picoseconds. In reality, the speed of the device is determined by the geometric size of the element and the speed of peripherals forming the control currents.

An experimental model was built and tested. The size and switching dynamics may be optimized, and SQUID may be used as shift registers or XOR elements. These devices can be used in communications, image processing, and delay measurement. Figures 6; references 15: 8 Russian 7 Western.

UDC 621.382

Switching Processes of Information Cells in Magneto-Optic Controlled Transparencies. 1. Critical Parameters of the Monodomain State907K0295B Moscow MIKROELEKTRONIKA
in Russian Vol 19 No 3, May 90 (manuscript received
21 Jan 1989) pp 232-238

[Article by L.G. Onopriyenko, A.Ya. Chervonenkis]

[Abstract] Magneto-optically Controlled Transparencies (MOCT) with electrical addressing have come into widespread use for flat displays, fast printers, and real time systems of optical signal processing. MOCT are spatial-temporal light modulators based on an magneto-optic medium.

A cellular matrix can be formed in the film medium by local diffusion annealing in the presence of a reducing agent (usually silicon). A periodic system of magnetized (M_1) cells is formed in a film with an initial magnetization (M_2) and a labyrinth domain structure. When $[M_1/M_2]$ is small the cells have a stable monodomain structure suitable for recording binary information. The stability of this state depends on M_1/M_2 and other factors. The magnetic and geometric parameters of a film with a cellular structure are found for which a monodomain state is realized. It is only possible to use a cellular-structure film as a MOCT at

certain correlations of magnetic and geometric parameters. The film is not suitable for MOCT when a critical quality factor is exceeded or when $M_1 > M_2$. A monodomain state can only be maintained for small cell size, which is impractical. Figures 5; references 4: 2 Russian 2 Western.

UDC 621.382.8.001.2

Probabilistic Distribution Law of the Lengths of Interconnections907K0295C Moscow MIKROELEKTRONIKA
in Russian Vol 19 No 3, May 90 (manuscript received
18 May 1989) pp 304-308

[Article by B.N. Fayzulayev, V.V. Kamenskiy, A.S. Pervov]

[Abstract] While integration has increased, and the size of elements and switching delays have been reduced, the length of connections between chips had changed only slightly. The length of these connections determines the size of casings and the arrangement of chips on boards.

The use of average lengths of these connections is inadequate. This article obtains a probabilistic law for the distribution of lengths of interconnections, and compares these results with experimental distributions.

The law is found for optimized, partially optimized, and nonoptimized arrangements of elements, and for several special cases. A Rayleigh distribution is found to be a sufficiently good approximation of the lengths of interconnections. Figures 3; references 5.

UDC 621.382.8.001.2

The Average Delay of Signal Propagation in VLSI Interconnections907K0295D Moscow MIKROELEKTRONIKA
in Russian Vol 19 No 3, May 90 (manuscript received
18 May 1989) pp 309-311

[Article by B.N. Fayzulayev]

[Abstract] Unlike the linear dependence of signal delay on the length of the communication line in wave propagation, the dependence of the average signal delay in the interconnections of VLSI circuits with distributed RC parameters on the length of communication lines is quadratic.

Thus, the mathematical expectation of a signal propagation delay in VLSI interconnections is dependent on the distribution law for the length of communication lines.

Special cases are examined which illustrate the effect of the probabilistic law of the length distribution of lines on the average signal propagation delay in the interconnections.

Determination of the average signal propagation delay from the average length of interconnections is valid only for wave propagation, not diffusion propagation. For RC type interconnections, losses in the line cannot be ignored, and the delay increases proportionally to the square of the interconnection length. The average delay in propagation depends on the probabilistic law of line length distribution, and substantially exceeds estimates based on average lengths. Figures 1; references 2: 2 Russian, 2 Western.

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